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LIGHT *versus* HEAVY CABLES.

FROM 1851 to 1883 is over 30 years, yet this period has elapsed since the first practical submarine telegraph cable was laid across the English Channel. As is well known, this cable consisted of an insulated conductor surrounded with a padding of yarn and sheathed with an armour of iron wires. This pattern, designed in 1851, has practically been one which has been followed ever since, although, of course, certain improvements suggested by experience have been made. The only one of these improvements which is at all marked has been the serving of the iron sheathing, either separately or collectively, with a coating of yarn covered with a bituminous compound. This serving is intended to preserve the iron wires, and to prevent any broken ends of the sheathing from protruding and catching in the machinery during paying out, and it is a most valuable innovation. More recently, tarred tape has been substituted for the yarn, and the result has been a more finished surface to the cable. Practically, however, as we have stated, the original type of 1851 has not been departed from.

Although the idea of a light cable, that is to say, a cable protected with a hemp sheathing only, no iron or other metal being used, has been advocated more than once, it has never, from various causes, resulted in anything being done in the matter. Early in 1874, a company was formed, with a proposed capital of £380,000, for the purpose of laying a light cable to America, *viâ* the Azores. The primary object of this company was to promote cheap telegraphy by the use of light cables, by which ordinary messages could be transmitted at a uniform rate of one shilling for each word. The scheme was strongly advocated at the time by Sir Samuel Canning, Mr. Robert Sabine, Mr. C. F. Varley, Mr. Bordeaux and others, but owing to the little public support it received, the project fell through and was never revived.

The advocates of armoured cables do not, we believe, hold that light cables cannot be laid, but that they would not be durable, and, consequently, that they could not be recovered after the lapse of time. There is, we believe, abundant evidence to prove that hemp, under certain conditions, lasts very much longer than iron. At the recent meeting of the Society of Telegraph Engineers and Electricians, Captain Trott exhibited a sample of hemp which had been under water for *seventy-nine* years and was still perfectly good, and other examples of the durability of hemp under water have often, we believe, been produced.

It must not be overlooked, however, that the question does not turn upon the fact that in certain localities hemp is practically indestructible, but upon the question whether in the particular locality where the light cable is to be placed, its durability can be relied on. The advocates of the light cable system argue that iron rusts and loses its tenacity and then becomes a mere dead weight to be lifted (as it is often lifted) by the strength of the hemp alone, whilst the supporters of the armoured system state that hemp decays rapidly and that if it were not for the iron the cable could not be raised for repairs. The fact that iron does decay in certain localities is, we believe, unquestionable, but it is also certain that hemp decays under particular conditions. Assuming that it were equally possible to preserve the hemp and the iron, there can hardly be a doubt, we think, but that a hemp cable would answer all requirements for *deep sea* purposes at least, for the chafing against rocks which *must* take place in shallow water, cannot happen at great depths. A hemp-covered cable must, it is clear, have the advantage, as regards prime cost, over one of the iron-sheathed type.

Messrs. Hamilton and Trott in their excellent paper before the Society of Telegraph Engineers, certainly brought forward very strong arguments in favour of a light cable system for deep sea purposes, and it is to be regretted that circumstances did not admit of the discussion on the subject being adjourned to a future meeting, as much valuable information might have been forthcoming. As it was, the advocates of the iron-sheathed type of cable practically monopolised the discussion, leaving the adherents of the hemp-sheathed system but a few minutes for replying. Although, no doubt, the first speakers had had the advantage of an extended period over which their experience was spread, we think that their arguments, after all, were merely opinions *versus* facts. Captain Trott's statements were the results of actual observation, such as a person continually engaged in cable repairing has alone the advantage of having, and the results of such observation ought to be of far more weight than mere opinions based on a few meagre experiences. The arguments of Captain Trott cannot, we think, be accepted as being conclusive on the subject of the instability of iron-sheathed cables; they rather tend to prove that the laying of the cables which showed breaks due to a distortion or wringing of the armour, was carelessly done, and possibly the grappling was also effected in a manner upon which opinions may differ. Supposing, however, that an iron-sheathed cable is properly laid and can be relied upon for durability, the question of cost must still be largely in favour of hemp alone. The permanence of hemp can, we believe, be thoroughly assured under all conditions met with in the case of deep-sea routes, even under circumstances which up to the present have proved unfavourable, and we are convinced that the feasibility of the general idea will have to be tested sooner or later, as competition grows keener.

Prof. A. G. Bell.—At the Autumnal Meeting of the National Academy of Sciences, held at Newhaven, America, recently, Mr. Alexander Graham Bell submitted an interesting communication "Upon the formation of a deaf variety of the human race."

INSULATION RESISTANCE AND ELECTRIC LIGHTING.

WE were recently asked, in all seriousness, whether we should regard an insulation resistance of *1,000 ohms* per mile as sufficient for leads used for ordinary incandescence lighting, and from several other circumstances which have lately come to our knowledge, we are led to believe that, even now, this subject is but imperfectly understood by many electric light engineers and contractors. With the one exception of Mr. Fletcher Moulton's Provisional Orders for electric lighting, where he gives, as a sort of standard, an insulation resistance of 5,000 ohms per *volt*, which, however, is meaningless, we cannot at the moment call to mind any instance whereby an electric light contractor can obtain any figures on which to base his estimates. The rules issued by the Society of Telegraph Engineers and Electricians last year, contain only the vague remark that "the wires should be efficiently insulated." Mr. Heaphy's well-known compilation which he drew up for the Phœnix Fire Insurance Office, gives but the fact that "all wires should be thoroughly well insulated with a material rendered as non-inflammable as possible." Mr. Robert Sabine, in his paper on "Electric Light Leads," published in the ELECTRICAL REVIEW for January 6th of the present year, which article might be read and re-read with advantage, says: "In the judicious choice of an insulating material much of the success or failure of an electric lighting system may depend," and he concludes that vulcanised India-rubber is perhaps the best material at present employed, because it is specifically so good an insulator that a comparatively thin coating is sufficient, if mechanically perfect. It is at the same time diathermanous and it is not injured by an accidental heating up to the boiling point of water. A conductor covered but lightly with vulcanised India-rubber, would give an insulation resistance of at least 100 megohms per mile at an ordinary temperature, and, wherever dampness and moisture could affect the lead, we would in no case recommend a less insulation than this even for electromotive forces below 100 volts. For perfectly dry places, 20 to 30 megohms per mile might suffice, and such an insulation resistance as this can, of course, be obtained by the employment of inferior material. As we have always noticed a tendency on the part of electric light contractors to reduce the insulation resistance of leads as they get smaller, as, for instance, the conductors running through electroliers, we may at once say that these are quite as important as the mains. Indeed, their insulation should be more particularly studied, for they cannot be so well protected mechanically as larger leads, and therefore they are much more liable to be the cause of short circuiting in an electric light installation, owing to their fragile nature and the bending they are usually subjected to. The covering of wires should not merely be looked upon from an electrical, but also from a mechanical point of view, for a good lead should be capable of withstanding uninjured, bending, pulling, straining, or any other sudden shock. We think that contractors are sometimes misled by a mistaken notion of conductivity and insulation resistance. A person learns that a certain size of lead has a conductor resistance of one ohm, and an insulation resistance of one megohm, per mile, respectively. He thinks that one megohm is a very high resistance, amply sufficient for his purpose, and he selects this particular lead for his installation. He employs, say, at least 10 miles of wire, and overlooks the fact that while his copper resistance increases as the length of lead used, his insulation is going down in the same proportion, and that when his work is completed the insulation resistance of the whole circuit is only $\frac{1}{10}$th of a megohm. If some rules were framed showing the minimum amount of insulation resistance per mile to be employed for differing degrees of electromotive force, we feel sure that much of the uncertainty which now appears to exist, would be swept away, and we should have fewer complaints of electric-light installations breaking down. For machines producing alternating currents, modified regulations would be necessary, higher insulation being required.

VARLEY'S FLEXIBLE CARBON ARC LAMP.

THIS lamp is designed for the employment of the inventor's "flexible" carbons, which were patented last year (No. 2,776, 1882). The new lamp consists, in the first place, of a spool or coil frame, or holder, upon or into which the carbon candle may be coiled or otherwise folded. The ends of the candles are brought through conducting guides, by means of which the pole or burning ends of the carbon candles are brought together, for establishing the circuit to produce light. For feeding the carbon forward at the rate requisite for its consumption, conducting rollers or propellers are used, and a magnetic regulator determines the length of the arc. The centralisation of the latter is effected

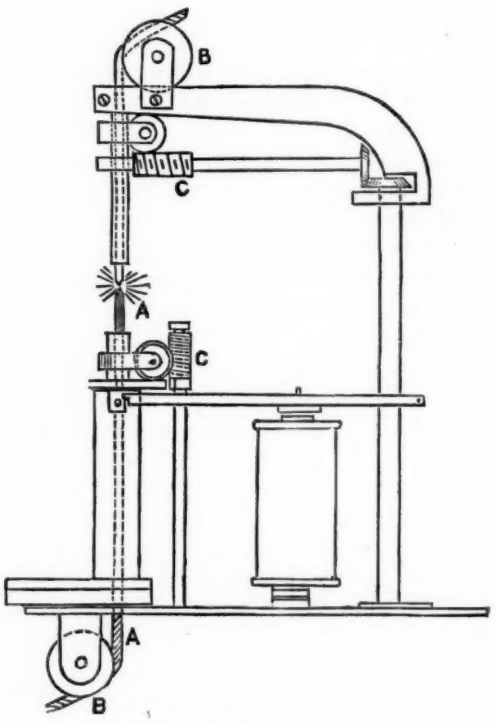


FIG. 1.

by means of a thermostat or variable resistance. The feed is regulated by a driving train of clockwork, controlled by an electric current, the rate of feed being determined by an automatic propeller, through which the lamp current passes.

Figs. 1, 2, and 3 represent various forms of the invention.

Fig. 1 shows a method of feeding the flexible carbon, A, the latter passing over rollers or guides, B, which are controlled by the worm and pinions, C, which are actuated by suitable mechanical contrivances, the upper worm being operated by mitre wheels as shown.

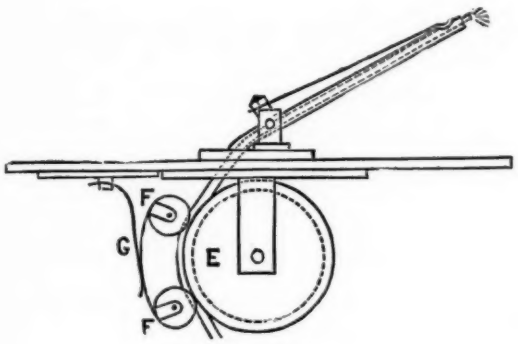


FIG. 2.

Fig. 2 is an arrangement somewhat on the principles of the Jablochkoff system, the flexible carbons passing through tubes and being conducted over the rollers, E, and guided by small rollers, F, controlled by a spring, G.

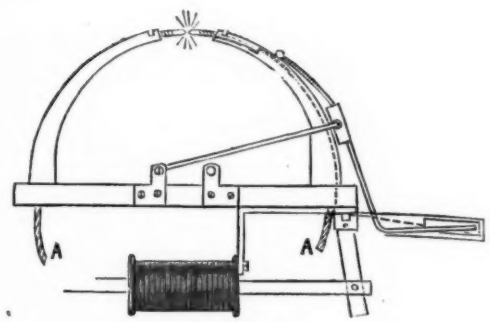


FIG. 3.

In Fig. 3, the flexible carbons are conducted in channels or grooves, being fed by the automatic propeller, which determines the rate of feed and likewise the potential of the current passing across the carbon poles.

REPORT ON SECONDARY BATTERIES.

(*Continued from page* 378.)

5.—COST OF THE H.P. HOUR OBTAINED FROM THE ACCUMULATORS.

The cost depends, to a great extent, on the amount of daily production.

We are about to give the particulars of a continuous trial, using on an average 400 H.P., supposing that the maximum shall be 500 H.P. and the minimum 300 H.P. In order that the work may be continuous we require one machine for changing, and the complete installation will comprise six machines of 100 H.P.

Estimate of the Installation.

Six compound engines, with condensers and variable cut-off, each producing, at a pressure of 7 kilo., and at a speed of 80 revolutions per minute, 100 effective H.P. at the fly-wheel	180,000 francs.
6 Belleville B 6 boilers, each making 1,275 kilos. of steam per hour, with foundations, smoke stack, and erecting, including 2 feed pumps	110,000 „
Counter-shafting, with brakes, speed cones, belts, &c.	60,000 „
Tools, hoisting machinery, &c.	20,000 „
18 Siemens S D_0 Dynamos	108,000 „
General installation-measuring and controlling apparatus	12,000 „
	490,000 francs

Or 500,000 francs.

COST OF WORKING.

Work furnished by the engines: 400 H.P. × 24 hours × 365 days—3,504,000 H.P.-hour.

Consumption of fuel: 1,100 grammes per H.P.-hour, or 3,900 tons of coal at 32 francs	124,800 francs
Oil, grease, rags, waste, cloths, &c., &c., 60 frs. per day	21,900 „
Condensed water and feed water at the rate of 200 litres per H.P., or 1,920 cubic metres on an average per day, at the rate of 25 francs per year for a cubic metre of water daily	48,000 „

Staff.

Chief engineer ...	6,000 francs	89,200 „
6 engineers (2 posts) ...	21,600 „	
10 stokers (2 posts) ...	24,000 „	
Chief electrician ...	8,000 „	
2 working electricians	8,000 „	
12 workmen	21,600 „	
Maintenance		25,000 „

Depreciation of Material.

5 per cent. upon steam engines and transmission	12,000 francs	38,000 „
10 per cent. upon boilers, tools, and dynamos ...	26,000 „	
Total		346,900 francs

for 3,504,000 H.P. hour, equivalent (at the rate of 46·5 per cent.) to 1,629,360 H.P.-hour disposable from the accumulators.

The cost of mechanical work will therefore be 21·3 centimes per H.P.-hour disposable from the accumulators.

To this cost we must add the cost of renewing the accumulators, represented, as we have previously pointed out, by a consumption of 250 grammes of material per H.P.-hour.

Taking into consideration the details of construction of the accumulators and the cost of the materials employed, we think we may adopt the figure of 600 francs per ton, as the cost of replacing the useful materials. The electrodes of the accumulators consist of lead plates cast in the form of network, of which the cells are filled with oxide of lead (minium and litharge). These plates dip into acidulated water (10 parts of water to 1 of sulphuric acid) contained in cemented wooden troughs. The actual price of lead being 32 francs per 100 kilos., and that of minium and litharge 45 francs per 100 kilos., the figure 600 francs seems justified.

The wearing away of the accumulators represents therefore an expense of 15 centimes per H.P.-hour. We should deduct from this expense the value of the old plates; but as the durability of the negative plates and of the troughs is limited, and, as it is useful to

have a reserve for repairing or replacing them, we will allow that the cost of these various repairs will be covered by the value of the old plates.

Estimating the general working expenses at 250,000 francs per annum, the price of the H.P.-hour disposable from the accumulators could be put down as follows :—

Mechanical work	21·3	centimes.
Maintenance and renewal of accumulators	15·0	„
General expenses	15·4	„
Price of the H.P.-hour at the works	51·7	„

6.—Cost of Distribution.

The cost of distribution per H.P.-hour will depend on the distance between the works and the place of consumption as well as on the mode of distribution adopted.

If the transmission is made by cable, we may compare the network of conductors with a system of water or gas pipes, and estimate the first cost of these conductors at 500,000 francs, while their maintenance and depreciation will represent an annual expenditure of 50,000 francs, or 3·1 centimes per H.P.-hour.

The price of the H.P.-hour distributed by cable would be as follow :—

Price at the works	51·7	centimes
Loss of energy in the conductors 10 per cent.... ...	5·2	„
Maintenance and depreciation of the system	3·1	„
Total	60	„

If the distribution is effected by cartage, the price at the works (51·7 centimes) must be increased by the cost of carriage of the accumulators both ways, which may be estimated at 75 centimes, or 1 franc per H.P.-hour with a suitably arranged service.

7.—Cost of Incandescence Lighting by means of Accumulators.

We have made this trial with the type of Swan lamps adopted for lighting the Grand Hotel; the electromotive force varied during our observations between the extreme limits of 44 and 48 volts.

Experiments made upon four lamps at the Grand Hotel gave the following results :—

1. With an electromotive force of 44 volts and a current of 0·64 ampères, the illuminating power was 1·31 carcels for an expenditure of 2·872 kilogrammetres per second.

2. With an electromotive force of 48 volts and a current of 0·75 ampères, the illuminating power was 2·02 carcels for an expenditure of 3·672 kilogrammetres per second.

The mean of the two series gives 1·665 carcels for an expenditure of 3·272 kilogrammetres per second.

Allowing for a loss of 10 per cent. through the resistance of the internal conductors, we find that the H.P. hour furnished by the accumulators would supply 20 lamps.

The cost per hour will therefore be

Work furnished by the accumulators...	3	centimes.
Maintenance and renewal of lamps ...	1·5	„
Total ...	4·5	centimes.

for a lamp having a luminous intensity of 1·67 carcels.

The experiments of illumination at the Grand Hotel have given us some useful information concerning the rendering of accumulators. This illumination comprises nearly 700 Swan incandescence lamps. They are supplied by a battery of nine series of 21 accumulators each, charged by five gramme machines driven by a steam-engine which works from 10 o'clock a.m. until midnight.

The current furnished by the dynamos is employed from 10 o'clock a.m. until 5.45 p.m. to charge the accumulators; after this time the lamps are lighted and absorb the entire current from the dynamos, as well as a variable quantity furnished by the accumulators.

Observations made with this installation during the day and evening of September 21st gave the following results :—

The quantity of electrical energy supplied to the accumulators up to 5.45 p.m. was 37·3 H.P. hours; from 5.45 p.m. until midnight the total quantity of energy supplied directly to the lamps by the dynamos was 44·7 H.P. hours.

The total work consumed by the lamps during the evening from the 21st to the 22nd September was 69·7 H.P. hours, of which 44·7 was furnished directly by the dynamos and the remainder, or 25, by the accumulators.

The rendering of the accumulators, calculated for the evening is therefore equal to $\frac{25}{37{\cdot}3} = 67$ per cent.; admitting that their electrical condition, which would not differ perceptibly in reality, was the same at the end as at the beginning of the day.

8. The Application of Accumulators to the Traction of Tramcars.

Whilst awaiting the new trials, which will give more complete data upon this question, we shall point out the results obtained from the experiments on the traction of of a tramcar made, on September 26th, from Paris to Versailles.

The motive power was furnished by a battery of 109 accumulators of the 17·5 k. type, coupled in series, and arranged for using, according to requirement, 50, 70, 95, or 109 elements.

The weight of the car was ...	3,500	kilos.
The weight of the accumulators (the accumulator, containing 17·5 kilos of useful material, weighs 30 kilogrammes with the box and the liquid) ...	3,200	„
The weight of the passengers ...	1,100	„
Total weight	7,800	kilos.

The distance travelled from the place de la Nation at the depôt of the Compagnie des Omnibus at Versailles was 23,900 metres; the difference of level between the points of departure and arrival being 78·40 m.

The raising work was ...	611,520	kilogrammètres.
Admitting, as is generally done, that the co-efficient of friction upon the tramway is 0·01, we find that the work of traction was	1,864,200	„
Total useful work ...	2,475,720	kilogrammètres, or 9·17 H.P. hours.

The work furnished by the accumulators during the entire journey was 4,751,813 kilogrammètres, or 17·6 H.P. hours. The journey was performed in two hours and twenty minutes, or at the rate of 10 kilometres per hour, including stoppages.

In order to complete the experiment it was necessary to determine the work expended in returning the car to its point of departure. An unforeseen circumstance prevented the performance of this experiment.

A car being benefitted in returning by the elevation acquired in going out, we may admit that the expenditure of work for the double journey would be the same as if the total course had been on a level; that is to say, in practice, the total work of going and returning would be only 1·51 times the work of going, which would represent a work of 26·6 H.P. hours for the total journey of 47·8 kilometres.

The work of traction being, all other things being

equal, proportional to the weight to be moved, if the car had had its complete weight of passengers, estimated at 3,500 kilos, the total weight would have been 10,200 kilos and the work required 35 H.P. hours.

If we apply this result to the traction of an ordinary tramcar of which the average journey is 92 kilometres per day, we find that the work required per day will be 67·4 H.P. hours, which we will raise to 74 H.P. hours, to allow for the work lost by stoppages, which will be more numerous on a passenger service than on an experimental journey.

The cost price, at the works, of the H.P. hour disposable on the accumulators, being 51·7 centimes, including general expenses, the expense would be 38·25 francs per car and per day, plus the cost of lubrication and maintenance of the dynamo-electric machines or motors.

We regret that in the little time allowed to us for this experiment we were unable to render it more complete, but we hope that the occasion is not far distant when we shall be able to investigate it in all its details.—*L'Electricité.*

A COMBINED ELECTRIC PUSH BUTTON AND FIRE ALARM.

THIS invention, devised by M. L. J. H. Eon, is an extremely neat and ingenious piece of apparatus. Fig. 1 is an elevation of the arrangement, the cover, C, and push piece or button, B, being removed in order to show the internal arrangements. Fig. 2 is a transverse section taken along the line 1—2

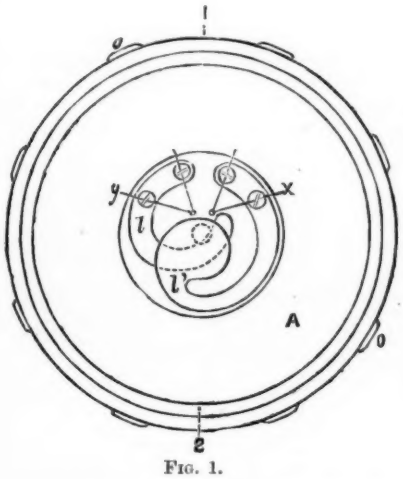


FIG. 1.

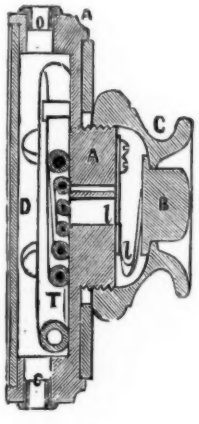


FIG. 2.

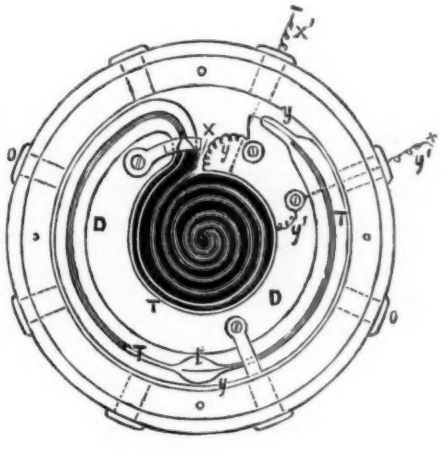


FIG. 3.

fig. 1, and fig. 3 is an elevation viewed from behind, the back plate being removed. The apparatus is supported by a plate or body part, A, of wood or other suitable material, provided on one side with a pair of contact makers or circuit closers, which may consist of a fixed plate, *l*, connected with one of the poles of the battery, and a spring, l^1, in the form shown in fig. 1, connected with the other pole of the battery, the free extremity of the spring, l^1, being acted upon by a knob or button, B, sliding in the centre of a cap or cover, C, screwed on to the plate, A. By pressing this button, B, the spring or moveable contact maker, l^1, is caused to come into contact with the fixed plate or contact maker, *l*, and close the circuit, thus enabling the bell or annunciating apparatus to be worked in the ordinary manner. In a recess or chamber, D, at the back of the part, A, a thermometer, T, is set, preferably of a coiled or spiral form, and containing mercury, which mercury is placed in communication with one of the poles of the battery by means of a wire, *x*, preferably of platinum, connecting the mercury in the thermometer with a wire, x^1, forming one of the conducting wires of the apparatus. In the part of the thermometer tube, T, which at ordinary temperatures does not contain mercury, a wire, *y* (also preferably of platinum), is arranged, communicating in a similar manner with the other pole of the battery through a wire, y^1, forming the other conducting wire of the apparatus. One extremity of the wire, *y*, is contained in an enlargement or swelling, *t*, formed in the tube of the thermometer, and the distance between this wire and the mercury is so regulated that, when a given temperature is reached, the mercury by expanding enters the enlargement, *t*, and comes into contact with the end of the wire, *y*, thereby closing the electric circuit and actuating the bell or alarm giving apparatus. The enlargement or swelling, *t*, in the thermometer tube is provided for the purpose of allowing the mercury to retire quickly when the temperature is lowered, so that the mercury may not be liable to make contact for too long a time.

THE RESULTANT MAGNETIC FIELD IN THE DYNAMO.

I HAVE noticed in the ELECTRICAL REVIEW and other papers, formulæ for calculating the current produced by the revolution of the armature of a dynamo, in which the current generated is calculated from the effect of the resultant field upon the armature. But the resultant magnetic field of a dynamo is produced partly by the field-magnets and partly by the current in the armature; and to assume that that component of the magnetic field which is produced by the current in the armature assists in the generation of the current in the armature is equivalent to assuming that a current when moved in its own magnetic field is thereby increased in strength; and this is known to be impossible.

The current, therefore, in the dynamo would be generated only by that component of the magnetic field produced by the field-magnets.

I have also seen publications in which the resultant field is assumed to pass through the armature at the points where the brushes produce no sparking. But this theory may be easily proved incorrect, because the resultant field varies in position with the strength of the current in the armature, and the current in the armature varies as the reciprocal of the resistance of the circuit and as a function of the velocity of rotation of the armature. But by varying the resistance of the circuit no sparking is produced at the brushes, although the position of the resultant field must be altered. This fact proves that the lead of the brushes has nothing to do with the position of the resultant magnetic field. But, on the other hand, if the velocity of the armature is varied it is found necessary to alter the position of

the brushes to prevent sparking taking place; thus proving that the lead of the brushes solely depends upon the velocity of rotation of the armature.

It would, therefore, appear that the theory first advanced to account for the lead of the brushes is the correct one, namely, that the lead is simply proportional to the time required for the armature to magnetise and demagnetise.

W. MOON.

THE WESTINGHOUSE AUTOMATIC ENGINE.

IN the ELECTRICAL REVIEW for December 1st we gave an illustration of one of these engines, coupled direct to an Edison dynamo. Through the courtesy of the Westinghouse Machine Company of America, we are enabled to place before our readers further illustrated particulars of these engines, which appear to be extensively employed by the leading electric light companies on the other side of the Atlantic. Fig. 1 represents a rear view of the engine with one fly-wheel removed, and fig. 2 shows a vertical section through shaft and cylinders.

The cylinders, A, A, are cast in one piece with the valve chamber, B, and are bolted to the top of the bed or crank case, C.

The cylinder heads, *a*, *a*, cover the upper ends of the cylinders only, the lower ends being uncovered and opening directly into the chamber of the crank case.

The pistons, D, D, are of the "trunk" form, double walled at the top to prevent condensation, open at the bottom, and carrying the wrist pin, *b*, *b*.

The annular exhaust, E, E, is a narrow belt surrounding the cylinder, opening into it by the ports, *e*, *e*, and communicating directly with the exhaust outlet.

The position of the annular exhaust is such that the ports, *e*, *e*, are uncovered by the piston, D, just before the completion of its stroke.

The connecting rods, F, F, are hollow and are subject to compression only; the cranks, G, G, balanced by the bobs, *x*, *x*, the crank pin, P, and the crank shaft, H, H, are all of steel, and may be removed by taking off the crank case head, *c*.

The crank shaft bearings are in the form of removable shells, *d*, *d*, lined with babbitt metal which is expanded into place under a hydraulic pressure of 15 tons per square inch of surface.

The valve is of the piston variety, of improved construction, being built up from a neck, and spider heads of malleable iron, and the whole bound together by a hollow valve bolt.

The valve guide serves also in lieu of a stuffing-box against the exhaust steam contained in the passages above it. The valve guide, as well as the valve, and both pistons, are packed with simple sprung rings of cast iron, having their depth about twice their width of face.

The valve stem is keyed fast to the guide, and grips the valve without binding between the nut at the upper end and the collar at the lower end.

The eccentric is in halves, clamped to the shaft by bolts, keyed to prevent slipping, and balanced by the bobs, *o*, *o*, cast in one piece with it. The eccentric strap, L, actuates the valve through the hollow eccentric rod, *r*. Water is supplied to the crank case through a pipe, not shown in the drawing, and the level indicated in the funnel head of the overflow pipe. Oil for the lubrication of all the internal parts *may* also be added through the same pipe, but is preferably fed from time to time through the oil cups, *f*, *f*, on the main bearings, whereby their proper lubrication is first assured, and the oil afterwards returned into the case by the wipers, for the benefit of the crank pin, and all the other bearings. No other oiling than through these cups is required.

In designing the Westinghouse engine, the special points aimed at were: To render it, by its extreme simplicity, and the peculiarities of its design as to adjustments, keying up, packing, oiling, &c., independent of the careless attendance of an unskilled engineer.

To reduce the requirements of repairs to a minimum by making the good performance of the engine independent of wear.

To make the repairs, *when required*, at the lowest possible expense of time and money by *renewing* (not patching up) removable and inexpensive wearing parts *only*, thus maintaining the engine in all essential respects *new*, even after long use.

To secure high speed, and to retain a proper grade of fuel consumption.

As the engine is being introduced into this country by Messrs. Alley & Maclellan, electric light engineers will doubtless have an opportunity of judging for themselves, as to whether the claims advanced in its favour are justified. Its advantages may be summarised thus:—High speed if necessary, compactness, economy of oil, the working parts are enclosed, the engine is self contained, less weight per H.P., complete interchangeability of parts, and a high degree of economy per indicated H.P., together with several other minor items. The following sketches show

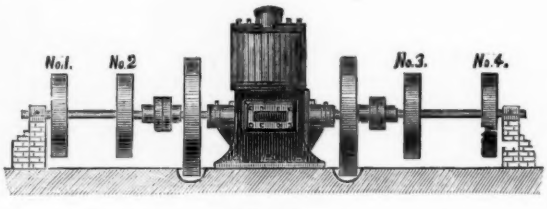


FIG. 3.

methods adopted by the Westinghouse Company for electric lighting plant. The company hitherto has thought it preferable to drive each dynamo, or at most two dynamos, from a single engine. Should it be

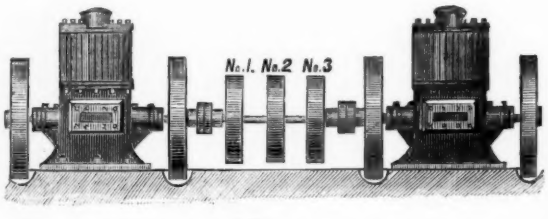


FIG. 4.

desirable to drive three or more machines from a single large engine, shafts are coupled direct to one or both ends of the engine shaft, the outer ends being carried as shown in fig. 3.

Fig. 4 represents a pair of smaller engines, cranks quartering, to each end of a shaft of required length which carries the driving pulleys.

American Telegraphs.—The American President in his message to Congress, says: "he sees no reason to change the view expressed last year that the Government should not assume the same control over the telegraph as it exercises over the mail service which admits its authority. It would not, in his opinion, be a wise use of that authority to purchase or assume the control of the existing lines, or to construct others for the purpose of competing with them." President Arthur, however, avows his belief that the Government should be authorised to exercise some sort of supervision over Inter-State telegraphic communication, and hopes that a measure may be enacted with that object.

THE WESTINGHOUSE AUTOMATIC ENGINE.

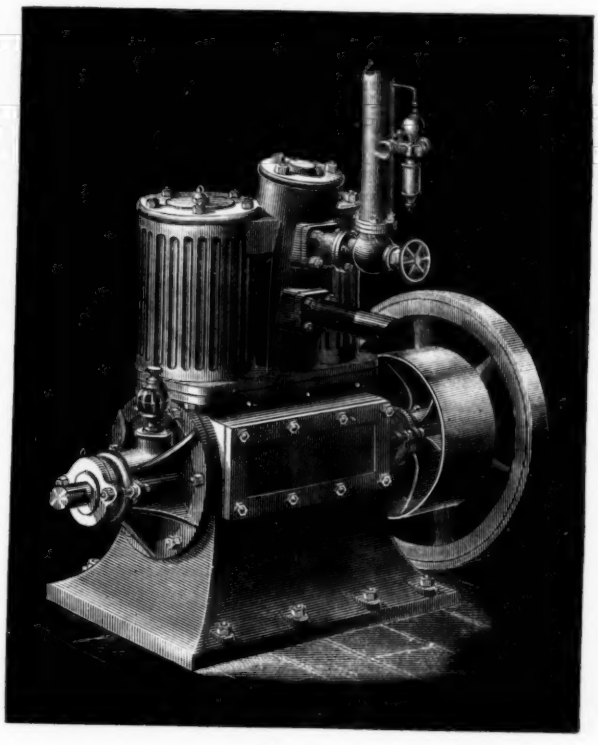


FIG. 1.

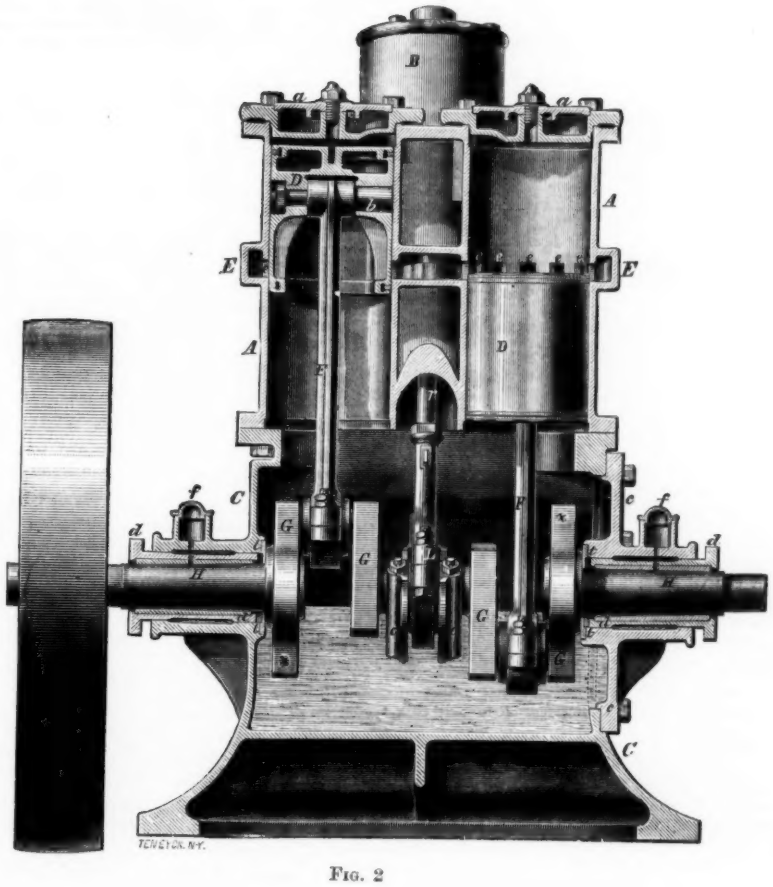


FIG. 2

ON ELECTRICAL CONDUCTORS.*

By WILLIAM HENRY PREECE, F.R.S., M. Inst. C.E.

In no branch of engineering has the mutual dependence and reaction between practice and theory been more beneficial than in the useful appliances of electricity. Without theory the rule-of-thumb telegraphist would have been stationary. Without practice the electrician would have been a dreamer. The practical difficulties of telegraphy incited the physicist to trace out the laws that govern the behaviour of this subtle power of nature, and the appearance of new facts has driven the practical telegraphist into lines of inquiry and discovery. Physicists have been metamorphosed into practical engineers, while no telegraph engineer deserves that title unless he also possesses that of a scientific man.

These conclusions are very strongly illustrated in the improvements made in the quality of the conductors employed for the transmission of electric currents.

Copper.—In the first telegraphs of 1837 nothing but copper wire, owing to its high position as a conductor, was used in England, and it was buried underground, but the difficulty then experienced in insulating buried wires was so great that they were removed from underground and suspended on poles.† The ductility, the want of tensile strength, and the absence of elasticity of copper, as then produced, rendered it impracticable for this purpose. It was speedily replaced by iron. Iron has since been almost universally used for aerial lines, while copper remains the sole material for underground and submarine purposes where mechanical strength is of little consequence. Mechanical strength and price seem to have been the only considerations that governed the choice of conductors in the earlier days, but as soon as speed of transmission became a commercial question, as it did in 1858, when Atlantic telegraphy became *un fait accompli*, then the electrical qualities of the material engaged the attention of the telegraph engineer. Sir William Thomson in 1856 pointed out the great differences in conductivity observable in various samples submitted to him, although these samples were supposed to be of the very best quality; while Matthiessen in 1860 made an exhaustive inquiry into these variations and their causes. He determined the electrical conductivity of pure copper, and defined a standard which is that now in use,‡ and showed that the variations were due to impurities, principally oxygen and metalloids. A mere trace of arsenic reduced the conductivity 40 per cent., while contact with air when in a molten state reduced it 24 per cent.

The result of Matthiessen's inquiries has been not only to remove the great variations in the conductivity of the copper, but to immensely improve its quality. While in 1861 electricians were content to specify that the copper should not fall below 85 per cent. of pure copper, they now specify 96 per cent., and they obtain it of a remarkable uniform quality. The value of this improvement may be estimated from the fact that the carrying capacity of a cable for messages is increased in the same proportion as the conductivity of the copper is improved. Thus a cable made of the copper of to-day will carry twice the number of messages that the same cable made of the copper of 1858 would carry.

The progressive improvement is shown by the following table:

Cable.	Year.	Percentage of Pure Copper.
Dover and Calais	1851	42
Portpatrick and Donaghadee	1852	46
Atlantic cable	1856	50
Red Sea	1857	75
Malta and Alexandria	1861	87
Persian Gulf	1863	89·14
Atlantic cables	1865	96
Irish cable	1883	97·9
Pure copper	...	100

But it is not alone in cables that an improvement of working has been effected by increasing the conductivity of the copper. It has imported additional efficiency to the apparatus. Greater useful effects are obtained with the same current. In all the practical applications of the current, it has an economical advantage, for it lessens the waste of energy in the circuit in direct proportion to the improvement effected. In an electric light main a difference of 10 per cent. in the purity of the copper might lead to the waste of several H.P. The test for purity is extremely simple. Every text book or book of tables has the resistance of a foot-grain, a metregramme, a mile-pound, or a knot-pound,§ of pure copper at every degree of ordinary temperatures—call this R_t. Take a piece of the cylindrical conductor to be measured. Let w be its weight, l its length, then

$$\frac{R_t\, l^2}{w} = r_1$$

gives its resistance at the temperature at the point of observation if it be truly cylindrical and the copper be pure; but by actual measurement it will be found to be r_2. Then

$$\frac{r_1}{r_2} = \frac{100}{x}, \text{ or, } x = 100 \times \frac{r_2}{r_1}.$$

and x is its percentage of purity.

The resistance of all metals is very much affected by temperature. Matthiessen studied this with great care. He found that within ordinary limits the increase due to higher temperatures was approximately expressed by the formula,

$$R_t = R_0\,(1 + a\,t),$$

where R_0 is the resistance at 0° C., and R_t the resistance at the temperature t. He determined the coefficient a to be for pure copper 0·0038. Thus the resistance is increased 38 per cent. between freezing and boiling point, and it may therefore be increased 20 per cent. between winter and summer temperatures. Hence it is desirable to determine the efficiency of electric-light leads at the highest temperature to which they will be exposed to avoid unnecessary and injurious waste of energy.

But copper is not only used for submarine cables and for underground lines; it is also employed for overhead wires through towns and many smoky districts. It is not so readily attacked by the gases in the air as is iron or zinc. For such purposes, however, mechanical strength, which is of little consequence in insulated wires, becomes of essential import.

Copper wire when in the process of manufacture is always drawn cold, and is said to be "hard-drawn" before it is subjected to the annealing process, after which it is called "soft." Soft copper always gives a higher conductivity than hard-drawn copper, but its tensile strength is reduced. Pure soft copper has a very small breaking strain, probably under 10 tons on the square inch, but hard-drawn copper is now supplied that has a breaking strain of 28 tons on the square inch.

Copper wire has been erected in localities where iron wire is destroyed in a few months, and now, after four years' experience, it appears practically unaltered. The diameter has not been reduced $\frac{1}{10000}$ of an inch, and it maintains its original qualities unimpaired. In the neighbourhood of chemical, varnish, and other works it becomes encrusted with a thick deposit, but beneath this it remains unaffected.

Age alone, as far as experience extends, seems to have no appreciable influence on the quality of unstrained copper. Its conductivity and its ductility remain constant. But when copper wire has been removed from magnet coils, such as the field magnets of a dynamo it becomes brittle, but curiously enough this seems to occur even when the magnets are out of use, for Mr. Sabine has found that silk-covered wire, particularly of the finer sizes, wound upon experimental apparatus, gets in a few years equally brittle, whether the instrument is thrown aside or whether it is continually at work. Neither paraffin nor electro-gilding check this brittleness. It is probably an effect due to the strains that the wire experiences when wound on a reel and subject to the incessant variations due to changes of temperature.

Matthiessen could find no differences produced by the passage of electric currents. The conductors of the Atlantic cables laid in 1858, 1865, and 1866 are found as perfect now as when they were made. The conductors of all cables seem to remain constant. But Gaston Planté* found that the continued discharge of great quantities of electricity through fine wires rendered them brittle, and Callaud asserted that he found lightning conductors very brittle. If that be so, some result may be anticipated from the employment of currents for electric lighting. At present experience is scarcely long enough to teach much on this point.

It is well known that impure copper and its alloys, particularly brass, become brittle when exposed to atmospheric influences in workshops, but this influence has not been observed in telegraphic conductors.

Wires more than twenty years old, used as battery leads, and constantly subject to the transference of electricity through them, showed no signs of deterioration. The experience of telegraph engineers is entirely in favour of the constancy and durability of copper as a conductor.

The size of conductors is governed by strictly theoretical conditions dependent upon the purposes to which they are applied and it is controlled by commercial considerations. In telegraphy speed of working is the criterion; in electric lighting, and in the transmission of power, waste of energy is the criterion. Sir William Thomson has given a law which indicates that the annual value of the wasted energy must equal the interest on the capital expended in laying down the conductor to give the maximum useful economic result. Any departure from this law to secure lower capital expenditure means shortsighted policy and non-scientific practice.

Copper is imported into the country either as ore or regulus, bar or ingot. The purest comes either from Japan, Chili, Australia,

* Read before the Institution of Civil Engineers, Dec., 1883.

† In 1848 a copper wire was put up between Paris and Rouen.

‡ Matthiessen's standard is 100 inches, weighing 100 grains, giving 0·1516 ohms at 60° Fahrenheit.

§ 1 metre weighing 1 gramme = 0·144 ohms at 0° C.
1 foot " 1 grain = 0·2064 " "
1 knot " 1 pound = 1091·22 " "
1 mile " " = 842 " "

* "Comptes Rendus de l'Académie des Sciences," vol. lxxxix., 1879.

or from Lake Superior. Much pure copper is produced by the Swansea method of copper-smelting, especially by the modification of that system known as "best selecting," but within the last few years very pure copper for electrical purposes has been obtained by improvements in the treatment of the metal in the smelting and refining furnaces, some of which have been so successful that there is no difficulty in getting metal giving an electrical conductivity equal to 99 per cent. of pure copper. Great purity of copper is also arrived at by electro-deposition, of which there are two methods—the one by depositing the metal from a solution obtained from the ore, the other by using impure copper as the anode in a depositing bath containing a standard solution. Electro-deposited copper has not the same mechanical strength as ordinarily refined copper.

At the Paris Electrical Exhibition of 1881 there was one coil of copper wire 1·3 millimetre in diameter, weighing 181 kilogrammes, and measuring 15 kilometres long.

Iron—Iron has been hitherto used exclusively for overhead wires. In the first days of gutta-percha, about 1849, iron was employed as the conductor to be coated with the new gum, but its inapplicability for this purpose was speedily discovered. Its abundance, its cheapness, and its admirable mechanical properties have singled it out for practical telegraphic purposes; but its resistance is very high, and materially increases the difficulties of the telegraphic engineer. The great improvements effected in the electrical qualities of copper, directed attention to the same qualities in iron; but although copper has been so vastly improved, the same progress has not been made with iron. Copper refiners have relied more upon the aid of the chemist than iron-wire manufacturers. In fact the improvements made have been forced upon the latter. The process in this case has been more tentative and less scientific. There is still room for progress. Although the Author had for many years advocated attention to this point, the Americans were the first to specify conductivity in applying for tenders. They defined a standard which was called the Ohm-mile—that is, it was the weight of a cylindrical wire one mile in length, which gave a resistance of one ohm at 60° Fahrenheit.

MECHANICAL AND ELECTRICAL TESTS OF SEVEN DESCRIPTIONS OF IRON TELEGRAPH WIRE.

Four samples of each kind.

Description.	Diameter.	Twists in 6 inches.	Elongation.	Breaking Weight.	Resistance per Mile reduced to 0·171 inch at 60° Fahr.
			Per cent.	lbs.	
"B B" puddled iron ...	174½	16	17½	1,470	14·4200
	176½	13	11½	1,380	13·5592
	165	14	15½	1,436	13·8897
	173½	17½	14	1,182	13·8983
"B B" piled iron, all puddled	171	16	17	1,220	14·0582
	164½	9	13	1,316	15·5820
	164½	12	11½	1,238	15·6234
	172½	17½	16½	1,292	14·1640
"Extra B B." Box piled of puddled and English charcoal, thus— E. C. | P | P | P | P | P | P | P E. C. [1]	168	11	14½	1,456	15·6191
	174	10½	15	1,538	15·3715
	169½	11½	16	1,398	15·5452
	172	12	14½	1,452	15·3017
"Extra special B B." Four-sided charcoal-piled English charcoal, and puddled thus— E. C. | P | P | E.C. | P | P | E.C. E. C. [1]	172	15	15	1,420	15·5129
	168½	14	14½	1,412	15·6844
	172	10½	14	1,484	16·3574
	172	15	16	1,478	15·5471
English Bessemer (known as homogeneous iron).	171½	20	16	1,634	15·9988
	169	19	13½	2,118	18·5663
	170	19½	17½	1,484	14·6922
	168¾	12	14	2,548	19·1480
Swedish Bessemer... ...	173½	21	17	1,392	12·6808
	174½	20½	12	1,380	12·9709
	173½	22	18	1,456	13·6587
	171½	13½	17½	1,318	13·0222
Swedish charcoal	171	23	13½	1,191	11·3490
	169½	25	10	1,358	11·3052
	169½	24½	13½	1,194	11·2241
	171¼	27½	13	1,128	11·3133

[1] E. C. = English charcoal. [2] P = puddled iron.

While the first iron wire supplied under this specification gave an ohm-mile of 5,500 lbs., it is now frequently obtained as low as 4,520 lbs. In the present specification of the Post-office the fixed maximum resistance is equivalent to an ohm-mile of 4,800 lbs.

The amelioration made in the quality of iron wire is illustrated by the following measurements:—

	Inch.	Ohms.
1873 Iron wire . . .	0·171	15·31 per mile.
1883 „ „ . . .	„	11·3 „ „

In the earlier days of the telegraph best puddled iron was used for wire, which, however, was very liable to splits and flaws, and an alteration was made by using piled puddled iron or B B (best-best). This description was again improved by the introduction of "box-piled iron" of puddled and English charcoal, sometimes called extra B B, and by four-sided charcoal-piled iron of English charcoal and puddled, which has been called extra special B B; but the terms B B, &c., have now lost all significance—the commonest description of fencing wire only being known by the term. During the last decade a mild English Bessemer steel has been very largely employed, especially for railway-telegraphs, and for staying purposes; but the resistance of most wires of this description is high, averaging about 6,800 lbs. per ohm-mile, the high resistance being mainly due to the high percentage of manganese which in this description of wire varies from 0·25 to 0·75 per cent. The wire used by the Post-office is Swedish charcoal, with an ohm-mile resistance, as already stated, of about 4,520 lbs. Swedish Bessemer, or a specially prepared low-carbon English Bessemer, is used by the India government, with an ohm-mile resistance of about 5,400. Cast-steel wire, with a breaking weight of about 80 tons to the square inch. has been adopted on the Continent for telephone circuits with an ohm-mile reistance of 8,000 lbs. The table will show at a glance the various descriptions of iron and steel telegraph wire which are now in use, or have been used, the tests being given for 0·171 inch, or 400 lbs. to the mile, that being the standard size in England, and a size very largely employed throughout the world.

It will be noticed by the preceding table, that while in England, where speed of working is the prime consideration, and length of span is negligible, electricians are satisfied with a breaking-strain of 22 tons on the square inch; in the Colonies, where long spans are essential, and speed of working is not so important, the specification is 30 tons on the square inch.

The following chemical analysis of samples of different wires, with their approximate resistances and tensile strengths when annealed for use as telegraph-wire, will be interesting:—

ANALYSIS OF SAMPLES OF DIFFERENT WIRE.

No. 1. Swedish charcoal iron, very soft and pure.
„ 2. Swedish charcoal iron, good for P. O. specification.
„ 3. Swedish charcoal iron, not suited for P. O. specification.
„ 4. Swedish Siemens-Martin steel, 0·10 carbon.
„ 5. Best puddled iron.
„ 6. Bessemer steel, special soft quality, 0·15 carbon.
„ 7. Bessemer steel, special hard quality, 0·45 carbon.
„ 8. Best cast steel.

No. of Samples.	1	2	3	4	5	6	7	8
Carbon	0·09	0·10	0·15	0·10	0·10	0·15	0·44	0·62
Silicon	trace	trace	0·018	trace	0·09	0·018	0·028	0·06
Sulphur	trace	0·022	0·019	0·035	0·03	0·092	0·126	0·074
Phosphorus	0·012	0·045	0·038	0·034	0·218	0·077	0·103	0·051
Manganese	0·06	0·03	0·234	0·234	0·234	0·72	1·296	1·384
Copper	trace	trace	trace	trace	0·015	trace	trace	trace
Iron	99·69	99·70	99·44	99·60	99·11	98·74	98·20	97·41
Ohm-mile at 60° Fahr.	lbs. 4,546	lbs. 4,502	lbs. 4,820	lbs. 5,008	lbs. 5,974	lbs. 6,163	lbs. 7,468	lbs. 8,033

This Table shows in a very striking way that the electrical conductivity of iron wire increases with the percentage of pure iron, except where the percentage of manganese is high; an increase in the percentage of manganese augments the electrical resistance considerably more than an increase in the percentage of sulphur or phosphorus.

The durability of iron wire is maintained by galvanizing—a most inappropriate title to a very simple operation. The wire, which is first chemically cleaned by passing through a bath of hydrochloric acid, is then drawn through a bath of molten zinc, at such a pace as will secure the adhesion of the requisite layer of zinc. The zinc becomes oxidised when exposed to the air, and since zinc oxide is insoluble in water, the wire is protected with an impervious coating; but when this zinc oxide is exposed to sulphur acids it becomes converted into zinc sulphate, which is soluble. Hence the zinc is removed, and the iron is exposed, when oxidation and destruction rapidly supervene.

When the galvanized wire is to be suspended in smoky districts it is additionally protected by a braided covering, well tarred. In some countries galvanizing is not resorted to, but simple oiling with boiled linseed oil depended upon. Such a wire was erected in 1856 between London and Rugby, but the result was very unsatisfactory. More recently (1881) the experiment has been repeated with a similar result. In this climate galvanization is imperative.

But it is not alone in smoky districts where iron wire decays. It suffers much along the seashore. The salt spray decomposes the zinc oxide into soluble compounds, which are washed away

and leave the iron exposed, and this is speedily reduced to mere thin red lines.

Where external decay is not evident, time seems to have no apparent effect on iron wire. Wire that has been erected for forty years seems as strong, as elastic, and as conductive as when it was first erected. In pure country air its durability seems infinite; but sometimes, especially through fir forests, it is subject to some corroding influence. Bauschinger* in 1878 tested iron taken from chain bridges that had been erected in 1827 and in 1852, and found the strength and elasticity unimpaired. Thurston found the same in Philadelphia after forty years' exposure. Thirty-nine years of incessant service in conveying currents for telegraphy have not apparently altered the molecular structure of the iron wires in the open country on the London and South Western Railway.†

Manufacture.—Swedish charcoal iron being now the only description used by the British Post Office, the author has selected it for describing the manufacture of iron telegraph-wire. It is imported either in bloom or in rods, principally in rods. Each rod is rolled down to about 0·260 inch in diameter, and weighs on the average about 1 cwt.

Iron wire used to be drawn in very short lengths, weighing from 15 to 20 lbs., involving numerous welds, splices, or joints—points of great weakness—but now they can be rolled and drawn into lengths longer than are practically required. Coils 0·171 inch in diameter, weighing 400 lbs. and measuring one mile, have been exhibited, but 110 lbs. is about the best practical limit for transport and use.

By the mills invented by Mr. George Bedson, of Richard Johnson and Nephews, Manchester, the blooms can be rolled in this country, without welds, into rods weighing upwards of 1 ton in weight; and the Author would mention *en passant* how much telegraph engineers are indebted for the modern improvements in telegraph wire to the various inventions of this gentleman.

The Swedish iron owes its value not only to its comparative purity, but to the fact that it is smelted and puddled entirely with charcoal; the best qualities are a mixture of various ores, and they are known by various brands, the conditions determining these brands being secrets.

The rods arrive in this country dirty and rusty, and the first operation performed on them is to clean them. This is done by immersion in a bath of diluted sulphuric acid, which thoroughly removes every trace of oxide and dirt. The clean rods are then coated with lime to prevent further oxidation, and well baked to dry off all trace of acid. One end of each rod is next pointed to admit of insertion in the draw-hole, and it is then drawn down by one operation to No. 5 W.G., or 0·212 inch diameter. The act of drawing the wire considerably modifies its molecular structure. It becomes "short," and before it can undergo a second operation of being drawn down to a smaller size it must be well and carefully annealed. It is then again cleaned and coated with lime, and drawn down to 0·171 inch in diameter. Since the drawing down has again shortened the texture, it has once more to be annealed before receiving its final operation of galvanization. After galvanization it is straightened by being drawn through a series of jockey rollers, and wound round two wheels, one of which has a slightly quicker motion than the other. It is finally gauged and tested before being stored away for future use.

The Author has described the manufacture of 400-lbs. wire, which is that principally adopted for telegraphic purposes in England, but the explanation is equally applicable to any other size—the wire after each drawing being annealed.

Testing.—The operation of testing is a most important one, and requisite not only for the user, but also for the manufacturer. Flaws, impurities, faults, notwithstanding the greatest care, will occur, and they can be detected only by the most rigid examination and tests. Tests are mechanical and electrical. The mechanical tests embrace one for breaking-strain, another for elongation, and a third for torsive capacity. For hard steel wire, in place of the torsion test, it is usual to specify that the wire shall bear wrapping round its own diameter and unwrapping again without breaking. In France the torsion test is replaced by another by which the wire is bent at a right angle backwards and forwards four times for wire 4 mm. in diameter. The electrical test is simply that for resistance—$\frac{1}{10}$ of a mile of the wire to be examined is wound round a dry wooden drum, and its electrical resistance is taken in ohms by means of a Wheatstone's bridge. Galvanization is tested by dipping in sulphate of copper, and by bending or rolling round a bar of varying diameter, according to the size of the wire. Special machines are constructed for the mechanical tests, the condition to be fulfilled being that for the breaking-strain the increasing load or stress shall be applied uniformly, without jerks or jumps, and the elongation machine shall correctly register the actual stretch without the wire slipping. The torsive capacity of the wire is determined by an ink mark which forms a spiral on the wire during torsion, the number of spires indicating the number of twists taken before breaking.

Specification.—The perfection to which the manufacture of iron wire has been brought is very much due to the care bestowed upon the specifications by the authorities of the Post Office and of the India Office. No lesson of experience has been neglected; no point has been left open to doubt. The standard has been gradually raised until it has attained a very high one indeed. It is now fixed, and not subject to those continual changes that are irritating and expensive to the manufacturers, who have in consequence been able to select their materials, and to ascertain by experiment the best methods of treatment to produce the high results required.

It cannot be too strongly urged that specification without rigid inspection is valueless. The manufacturer who for his own reputation, and in obedience to the dictates of his conscience, strictly complies with the requirements of a rigid specification at the expense of his pocket, without the check of a subsequent inspection, may exist in theory, but he is not found in practice. Equally difficult is it to find the careful and painstaking inspector who, possessing the requisite technical knowledge and experience, will rigidly perform his task, regardless of the blandishments of those whose interests are affected by his blindness or carelessness. Many administrations object to the expense of thorough inspection, and the result is they are the recipients of the rejected material of those who do rigidly inspect. One break in the wire costs far more than its inspection, and one extra ohm per mile affects the earning capacity of the wire in inverse proportion.

It is, however, necessary to remark that the mechanical quality of charcoal-iron wire sometimes changes with time—its electrical quality remaining unaffected. The molecules seem to set, and the wire to become harder. This is shown by a diminution in the number of twists and by an increase in the tensile strength. Tests repeated at some subsequent period may therefore be deceptive unless allowance be made for the effect of time. Bessemer or homogeneous iron wire as a rule improves in its mechanical properties by keeping in stock.

(To be continued.)

* The *Electrician*, October 16, 1880, p. 253.

† *Journal of the Society of Telegraph Engineers*, 1880, vol. ix., p. 44. "On the Durability of some Iron Wire." By William Henry Preece.

NOTES.

Electric Lighting.—As the electric lighting of the Indian troop ship *Malabar* has proved successful, the *Standard* of the 7th instant states that the Admiralty has entered into a contract with the Edison Company for similarly lighting the troop ships *Euphrates*, *Serapis*, *Jumna*, and *Crocodile*.

Several international exhibitions are announced as to be held in different parts of the world at an early date. The first of these will be held at Rouen, and the building, which has some architectural pretensions, is expected to be finished within the present year. The exhibition, which is to be specially illustrative of machinery, will be lighted by electricity, and is expected to be worthy of the old capital of Normandy.

At a recent meeting of the City Commission of Sewers, Mr. Ashby drew attention to the necessity for giving improved lighting arrangements at the junction of Cannon Street and London Bridge, where he had noticed with surprise that the small burners were being refitted, although at similar junctions throughout the metropolis the more effective burners, giving a largely increased light, were adopted. He made the same complaint with respect to the crossing at Victoria Street, in Cordwainer Ward, asking what steps were being taken to give there the improved light the Commission had ordered. Mr. Deputy Pepler replied that at the meeting of the Streets Committee, the question of lighting would be specially discussed, and the result would doubtless be, that they would recommend the issue of advertisements for the electric lighting of certain districts.

During the progress of the Fisheries Exhibition, the Government officials watched very carefully the various systems of electric lighting, and as a result, it is stated, that they have given the preference to the Ferranti system, and purchased a dynamo exhibited there for the purpose of lighting a portion of the South Kensington Museum.

We learn that Messrs. Faraday & Son having recently supplied the Swan electroliers for the state rooms, &c. of H.M.S. *Orontes*, are now making a similar class of fittings for the White Star s.s *Adriatic*. The same firm has just completed the electric fittings for Mr. W. S. Gilbert's house at South Kensington.

An experiment is being made in Newcastle, with the view of testing the merits of electricity as an illuminator of dwelling houses. For the last three months,

Mr. C. H. Gimingham, F.C.S., manager of the Edison and Swan United Electric Light Works at Benwell, has lighted his house in Park Road by electricity. Mr. Gimingham has dispensed entirely with the use of gas, and depends for the lighting of his residence upon forty low tension incandescent lamps of various candle powers according to their position. The lamps are arranged independently of each other, with the exception of the electroliers in which the lights are turned on and off in groups. The electrical energy is derived from a small Siemens machine, driven by a ½-H.P. Otto gas engine. Connected with the machine is a set of secondary generators which, while the engine is in motion, stores the energy for use when the motive power is not in operation. By this means, any of the rooms can be lighted up by the turning of a switch at any time of the night. No holders are used for the lamps, which are suspended from platinum wire hooks attached to flexible wire cords. They have small opal glass bell-shaped shades, which, while being a very inexpensive kind of fitting, renders the light not at all offensive to the eye. The lamps are placed singly or in groups in electroliers, and there is scarcely a corner of the house that cannot be perfectly lighted by their means. A novelty is an electrolier in the shape of a large basket of real ferns pendent from the centre of the ceiling, the lamps being placed amongst the foliage. The ferns, though in such close proximity to the lamps, have a very healthy look, and give a very pretty appearance to the room. Mr. Gimingham has fitted up his house with the electric lamps at a moderate cost, and has obtained an illumination that is both effective and agreeable.

"The Rhode Island Electric Lighting Company, of Providence, publishes a letter by Grant Brothers, of Olneyville, R. I., giving their experience with the incandescent lights (Maxim system) furnished by the company, and the cost of the electric light as compared with gas. Grant Brothers say they have had 167 lamps in use for six months, from April to October—say 1,460 hours in actual use. A breakage of 10 lamps per month, continues the letter, if continued indefinitely in the future, would indicate an average life of nearly 17 months—say 4,000 hours. This we do not expect, but think we are safe in counting upon an average breakage of not over 18 per month of 243 hours, giving a life of 9 months, or 2,200 hours.

Assuming the life of the lamps as 2,200 hours, we have as the cost of lamps per year of 3,360 hours an equivalent of 255 lamps, at $1.50 each	$382.50
Attendance, 1 man, at $9 per week	468.00
15 per cent. on cost of machines, shafting, belts, &c. ($4,328)	649.20
Oil, brushes, and sundry supplies, estimated	130.00
23 H.P., at 1.$\frac{25}{100}$ cents per H.P. per hour, for 3,360 hours	966.00
	$2,595.70
Cost of gas, 167 7-feet burners, 3,360 hours, 3,927,840 feet gas, at $2 per thousand	$7,855.68
In Providence we should be allowed a rebate on this quantity of gas, say 25 cents per thousand feet	
Cost of electric lighting $\frac{45}{100}$ of 1 cent per lamp per hour, equivalent to gas at 66 cents per thousand feet	
In our case we estimate the difference of cost per annum at not over	$500.00
Adding this to attendance, lamps and supplies, as above	980.50
And 6 per cent. for interest on plant	259.68
We have	$1,740.18

which may be regarded as the actual cost per annum so far. To this should be added a depreciation account, say of 8 per cent., $346.24: or a total of $2,086.42, which we believe to be a close estimate of the cost, to us, of 107 lamps, running or burning 3,360 hours per year, or $\frac{3}{8}$ cents per lamp per hour, equivalent to gas at 53 cents per 1,000 feet."—*Electrical World.*

A lecture upon the advantages of the electric light over other kinds of artificial illumination was delivered in St. George's Hall, Park Street, Deal, on Friday evening, Nov. 23rd, by Mr. A. J. Jarman; the subject of economical production, adaptation and subdivision was ably dealt with. Two of the "Faraday" dynamos of Mr. Jarman's make were employed for working both arc and incandescence lamps. The lecturer stated the cost of producing and maintaining the light with his machines in a clear and convincing manner, so much so, that the Deal people have taken him at his word, and have entered into an agreement with him to supply the machinery, at the price he stated, for lighting a portion of the town. It appears that Mr. Jarman's dynamo machines have been well tested during the past year and a half, and that they are not only efficient and reliable but are not easily put out of working order, even in the hands of inexperienced persons. We are informed that this machine will be employed in connection with Danchell's system of electric locomotion both as generator and motor, owing to its having proved itself a good and reliable machine in practice.

Telephony.—Recently at a meeting of the Works Committee of the Dundee Police Commission, Mr. Speed brought under notice the danger to the public from electric wires over houses and streets. Mr. Lumley, manager of the National Telephone Company, gave explanations, from which it appeared that in consequence of the lightness of the wires no danger need be apprehended by any of the lieges supposing any of the wires fell. The question of rent for wires was also under discussion. It was stated that in no town in the kingdom was any charge made by the Police Boards or Corporations. In these circumstances, and looking at the low rates exacted in Dundee for the use of the wires by the Companies, it was agreed to make no charge in the meantime.

The International Bell Telephone Company, Limited, which controls the Bell rights for the continent of Europe, proposes to issue $250,000 in 6 per cent. bonds to retire its floating debt, and provide money for construction purposes. These bonds will be offered to stockholders only at 80, each holder of six shares being entitled to subscribe for one $100 bond.

Telephonic Communication in Preston.—The telephone as a means of communication has been largely taken advantage of in Preston, and the wires now pass over the town like an intricate network. There is, however, says *The Preston Herald* of the 24th November, one great drawback to the completeness of the arrangements, and that arises from the fact that while some of the wires are in the hands of the Lancashire and Cheshire Telephonic Exchange Company others again are the property of Mr. Sharples, electrician, Fishergate. On this account there is not a universal communication and connection of wires over the borough. This is a want which forces itself strongly upon those who use the telephone, and the desirability of connecting the two lines is a matter which latterly has been the subject of considerable comment. There does not, so far as can be seen, appear to be any insurmountable difficulty in the way, and if we may suggest it, a meeting of subscribers, by way of a preliminary step, might lead ultimately to the attainment of the desirable result. While the matter would probably be of easy arrangement, the advantages to be derived would be incalculably great.

Rapid Erection of Telephone Wires.—Instances of the degree of skill attained by the National Telephone Company's staff in the erection of telephone wires, says the *Aberdeen Evening Express* of December 11th, have recently been afforded. The warehouse of Messrs W. Paterson & Sons, wholesale druggists, 133, Gallowgate, who have just become subscribers to the Exchange, is exactly 830 yards from the company's Market Street centre. The erection of the wire was commenced on Saturday last, and finished at 11.30 a.m. on Monday. The instrument was then in working order, and Messrs. Paterson in full communication with the other members of the Exchange, the work of connection having only taken six actual working hours. The connection of Messrs. John Bisset & Co., 37, Queen Street, was also begun on Saturday, and was completed at 4 p.m. on Monday, having occupied 5½ working hours. The con-

nection of Mr. James Butchart, Belmont Street, a few weeks ago, was even more remarkable. His order was received at 3.30 p.m., and although the men had to be recalled from the west-end of the town, the connection was complete, and Mr. Butchart speaking to his friends by its means a few minutes after six o'clock on the same evening, the whole erection having been made in about two hours.

The Teneriffe and Cadiz Telegraph.—The cable communication between Cadiz, Santa Cruz, and Teneriffe has been completed, and will probably in a few days be open to the public.

Proposed Cable to Suakim.—A Reuter's telegram from Cairo, dated December 12th, states that negociations have been resumed for laying a cable to Suakim, and that a favourable result is expected. The *Standard's* Cairo correspondent, telegraphing upon the same subject, says:—"After we had believed that all arrangements for laying a cable from Suakim to the Red Sea line were concluded, it is vexatious to find that fresh difficulties have arisen at the last moment, and that though there is little doubt of an ultimate settlement, an agreement has not yet been signed. The Eastern Telegraph Company practically demand the future monopoly, not only for Suakim, which will probably become important as the principal outlet of the Soudan, but for the whole Red Sea coast; and the Government naturally hesitate to grant so large a concession."

Telegraph Service Revenue.—*The London Gazette* of December 4th publishes a statement of the receipts and payments of the Exchequer, which shows the total received by means of the telegraph service, from April 1st to December 1st, 1883, to have been £1,215,000, against £1,175,000 the previous year. The estimate for next year is £1,750,000.

The Gale and Telegraphic Communication.—From accounts received, it would seem that the gale which was experienced more or less generally all over the United Kingdom on Tuesday night resulted in great damage to telegraph wires in various places. Although, as a rule, the wires and poles on the South London railway lines bore the enormous strain remarkably well, in a few cases the poles were torn from their sockets; and in other parts telegraphic communication was entirely cut off. This was so at Birmingham, and also at Glasgow, where communication with the south and many parts of Scotland was completely destroyed. Only one wire was available between Dublin and London, and it worked fitfully. Great disappointment was felt at the unfortunate breakdown, after elaborate preparations had been made for transmitting the report of the Parnell banquet, and it was only by an extraordinary effort that the principal speech was got through to London. Communication between Dublin and the north was completely cut off.

The Block System.—The block system is now in operation over the whole course of the main line of the North British Railway between Burntisland and Tayport, a distance of 35½ miles. The cost, independent of the employment of an additional staff of men to work the system, is between £20,000 and £30,000. The work was begun about a year ago. Arrangements are almost completed for the extension of the system to the Dunfermline and Stirling branch, and to that between Ladybank and Perth.

Proposed Mid-London Electric Railway.—Mr. J. W. Billinghurst, vestry clerk of St. Mildred's, Poultry and St. Mary-Colechurch, in a letter to the *Standard* of Monday last, called attention to the scheme for constructing a railway, under the name of the Mid-London Electric Railway, from Lancaster Gate in the West to Aldgate in the East, and urged reasons why the scheme should be opposed, stating that a maximum of inconvenience to the public generally would be caused by the selection of the busiest thoroughfares in the Metropolis. Replying to that letter in the *Standard* of the following day, Mr. Arthur T. Atchison, one of the engineers of the scheme, said it was proposed to construct the whole line by tunnelling from the station sites in both directions; there would thus be no obstruction to traffic or interference with the business of the tradesmen on the route during the progress of the works. The stability of lofty buildings along the line would in no way be imperilled, as it was proposed to tunnel throughout in the blue clay with an advancing shield, which would always be followed up closely by the permanent lining of the tunnel, thus avoiding any chance of the smallest slip in the roof or sides. No foul gases would be envolved by the motors, and, as the up and down lines would be in distinct tunnels, the working of the traffic would cause sufficient circulation of air throughout.

Her Majesty's Postmaster-General v. The Metropolitan Railway Company.—This was an important appeal, brought before the master of the Rolls and Lords Justices Baggallay and Bowen, in the Court of Appeal, on Monday, from the judgment of Mr. Baron Pollock and Mr. Baron Huddleston, who had ordered the defendants to erect cable and telegraph wires on their railway, between Gower Street and Portland Road Station, in conformity with an order of the Postmaster-General on December 1st, 1883, made under the Telegraph Act, 1868. The question was whether the Government was bound to pay compensation for the use of the defendant's line for the wires required in 1881, or whether the defendants had received all the compensation they were entitled to in respect of wayleaves, when a lump sum had been assessed by an award of Sir Henry Keating, made in January, 1879. Their Lordships dismissed the appeal without calling upon the respondent's counsel. The Master of the Rolls said the reasoning of the judgment appealed from was conclusive. The defendants had no power to prevent the Postmaster-General putting up the wires. The yearly rent was not imposed in respect of anything which the defendants were entitled to withhold, but it was a payment in the nature of compensation, and would be taken into account by way of deduction when the arbitrator settled the heads of damage. It had, however, been agreed that the arbitrator should not take into account any future advantages which might or might not arise. Lords Justices Baggallay and Bowen were of the same opinion.

Overhead Wires.—The Parliamentary Committee of the Shoreditch Vestry, reporting on this matter, said they agreed with the Newington Vestry that overhead wires ought not to be allowed, and that all telegraphic and telephonic wires should be underground. They had been informed by the vestry clerk that the vestry had no power to remove overhead wires unless they could be proved to be common law nuisances. The committee recommended the vestry to decline to join with St. Marylebone Vestry in any expense that might be taken in any legal action on the matter; and they suggested that the Government should be communicated with, and requested to determine the question of responsibility by legislative enactment. This was agreed to by the vestry.

Transmitting Power of Electricity.—Will electricity enable us to transmit power in large quantities more efficiently than other means? Will it enable us to transmit small quantities? These questions were put to the Society of Arts, and answered by Professor Osborne Reynolds in his Cantor lectures as follows:—Thanks to the experiments of M. Deprez, we can say that a current of electricity, equivalent to 5-horse power, may be sent along a telegraph wire $\frac{1}{6}$ in. in diameter, some ten miles long—there and back—with an expenditure of 29 per cent. of the power, because this has already been done. Compared with wire rope, this means fall short in actual efficiency, as Messrs. Hem. send 500-horse power along a $\frac{3}{4}$ in. rope. To carry this

amount, as in the experiment of Deprez, 100 telegraph wires would be required; these wound into a rope would make it more than 1·4 in. in diameter, four times the weight of Mr. Hems's rope. With the moving rope the loss per mile is only 1·4 per cent., while with the electricity it was nearly 6 per cent,; so that, as regards weight of conductor and efficiency, the electric transmission is far inferior to the flying rope. Nor is this all. With the flying belt, Mr. Hems found the loss at the ends, in getting the power into and out of the rope, 2½ per cent.: whereas, in M. Deprez's experiment, 30 per cent. was lost in the electric machinery alone, which is very small as such machinery goes. But this is not all. No account is here taken of the loss of power in transmission to and from the electric machinery. Taking the whole result, it does not appear that more than 15 or 20 per cent. of the work done by the steam engine could have been applied to any mechanical operation at the other end of the line, as against 90 per cent. which might have been realised with wire rope transmission. To set off against this, electricity has the enormous advantage in the conductor being fixed, and in the fact that it is likely to be, if anything, less costly and more efficient for small quantities of power than for large.—*Engineer.*

Electrical Cars.—On December 5th, about 10 o'clock p.m., a trial of a purely private character was made of a patent electrical car working by means of accumulators, specially constructed at the works of Messrs. Nigra & Co., Turin. This car traversed, upon two different occasions, the Rue de Nice, and returned to the point of departure without the slightest hitch (this course measured nearly 2 kilométres). The accumulators supplied at the same time an electric lamp which lighted the car perfectly. The car of Messrs. Nigra & Co., ran upon the pavement of the Rue de Nice, and not upon rails. The weight of the accumulators was 300 kilos, to which must be added that of the three persons which the vehicle carried. The firm of Messrs. Diatto is now constructing a very elegant electric car, upon Nigra & Co's. system, intended for the Exposition National de Turin.

Conversazione.—At the Hammond Company's Electrical Engineering College on Wednesday, a conversazione was largely attended by friends of the students and of the institution. An agreeable evening was spent in the examination of the scientific contents of the various rooms, including a Wheatstone's Automatic Telegraph Apparatus in action, the Phonograph and the machinery for producing the electric light, with which the building was lit throughout. A performance of music in the Lecture-room also formed part of the evening's amusement.

The City and Guilds of London Institute.—Prof. Huxley, president of the Royal Society, on Monday evening, presented the prizes awarded to the students of this institute, which has established, and maintains in the metropolis, model technical schools to serve as types of other schools to be founded and supported by local efforts in provincial towns. The Technical College, Finsbury, provides systematic evening instruction for those who are engaged in the staple industries of the district, and in the application of chemistry, mechanics and physics, to special trades, such as spirit rectification, mechanical engineering, and electric lighting. So considerable has been the development of the institute's operations that the council are compelled to appeal to the City and Livery Companies of London for additional subscriptions, to the amount of about £5,000 a year, to enable them to make the necessary provision for the maintenance of the central institution, which, it is expected, will be formally opened in May or June, 1884. The Lord Mayor presided over the proceedings on Monday evening, and there was a distinguished company present.

Leeds Association of Foremen Engineers and Draughtsmen.—In proposing the "Engineering Trades" at the Eighteenth Annual Dinner of this Association at Leeds on Saturday week, Mr. Reginald Wigram said, with regard to electricity, "It had been developed in a large measure on the other side of the Atlantic, and at the present time the leading electrical engineers were either French, German, or American."

We think that Mr. Wigram is quite mistaken, for American electricians of our acquaintance, and we have met many, invariably declare that the best electricians are to be found amongst the English and Scotch.

Collapse of the Electric Light at the Calcutta Exhibition.—*The Times* correspondent, telegraphing from Calcutta on December 9th, says, in reference to the failure of the electric light at the Exhibition, mentioned in our last issue:—"The total collapse of the electric light at the opening ceremony was at first attributed to a supposed cutting of the wires by some malicious person. An examination of the wires, however, has proved beyond doubt that they were not cut, but that, being too small to carry the current, they were fused by the heat."

The Spottiswoode Memorial.—A meeting was held on Friday, the 7th inst., at the rooms of the Royal Society, Professor Huxley presiding, when it was resolved that the national memorial of the late Mr. William Spottiswoode, should take the form of a pension in connection with the Printers' Pension Fund, and an influential committee was formed to carry out the necessary arrangements. At the same meeting a committee was appointed for the purpose of procuring a portrait or bust of the late Mr. Spottiswoode for presentation to the Royal Society, and also to consider the question of establishing a further memorial of his connection with that Society; this latter was understood to be a movement confined entirely to Fellows of the Royal Society, and independent of the other. In a letter to the *Times*, a correspondent signing himself "F. G.," expresses strong disapproval of the proposed form of the William Spottiswoode Memorial, viz., the founding of a pension for the widow of an incapacitated printer, and states his doubt whether any other memorial than a portrait, to be hung in the rooms of the Society, would be appropriate.

Society of Arts.—The Council at their meeting on Tuesday, elected Sir Frederick Abel, C.B., D.C.L., F.R.S., as their chairman in succession to the late Sir William Siemens.

The Recent Sunsets and Electricity.—Mr. W. H. Preece, writing to the *Times*, holds that electricity played a great part in the recent gorgeous display of atmospheric effects, and adduces argument in favour of his theory, to the effect that the mass of volcanic matter projected into the atmosphere in the Straits of Sunda was negatively electrified, and that, therefore, when the force of projection had become exhausted, the cloud of matter would be subject to the forces of repulsion, first of the electrified earth, and then the self-repulsion of each particle of electrified dust, causing a diffusion over a large area.

The Anglo-American Brush Electric Light Corporation.—We have received the catalogue just issued by this corporation, in which is lucidly set forth a description of the various electric apparatus supplied by them and the prices required for the same. The "Brush" dynamo-electric generator, automatic regulator, arc lamp and fittings are fully treated; but a new feature is the incandescence apparatus shown and explained, consisting of the "Victoria" generator, a Schuckert machine, modified to accord with the Mordey patents; automatic and hand-worked regulators, the inventions of Mr. Percy Allen, lately engineer of the corporation; and a number of incandescence lamp fittings, including sockets, attachments, switches, cut-outs, &c., pieces being detailed in every instance. The

publication is also a very useful one as showing by comparison the steady progress of the Brush system.

The Metropolitan Brush Electric Light Company, Limited.—In our "City Notes" columns will be found the report of the directors of this company, which will be read with interest by many, particularly when we mention that we were unable to get a copy upon application at the company's offices, although some were still in the secretary's possession, even after the shareholders had received theirs. The revelations made in the document itself account for this apparent want of courtesy, and beyond those in our issue of December 1st, no further comments are necessary regarding it. We may mention, however, that Mr. Keatinge Pollock has sent to all the shareholders of the company a powerful reply to the directors' statements; and we hear that a counter-circular is to be sent out. A lively meeting may therefore be expected on Monday, the position appearing to be this, that either the directors, if they regard their positions in the eyes of the commercial world as worth anything, must clear themselves from the imputations decidedly levelled at them, either by the clearest proof to their shareholders (which we confess seems to us difficult), or by taking proceedings against their late manager. The circular of this gentleman is so strongly worded, that we regret being unable to give it in its entirety to the public.

The London Contract Company, Limited.—According to an announcement appearing in the *London Gazette* of November 30th, at an extraordinary general meeting of the London Contract Company, held at the office, 10, John Street, Adelphi, on Thursday, October 18th, it was resolved that the company be voluntarily wound up, and that Mr. Henry Coe, of 4, Furnival's Inn, Holborn, and Mr. John Harry Evens, of 54, Wool Exchange, be appointed liquidators. This resolution was confirmed on November 14th, at a meeting held at 53 and 54, Wool Exchange.

The Electric Carbon Storage and Apparatus Manufacturing Company of Scotland, Limited.—We understand that directions have been given, in the winding-up proceedings in the High Court of Justice, for the sale by auction of the plant, stock in trade, and effects of this company, on December 20th, at Leith. Particulars of this sale may be found in our advertisement columns. An application was made on Monday last on behalf of the committee who were recently appointed (upon the invitation which appeared in our columns) to watch the interests of the creditors, that their solicitor might be authorised to examine into certain claims made against the company; and an order was made by the Chief Clerk of the Vice-Chancellor Kay giving such authority. The creditors will thus have the satisfaction of these claims being thoroughly investigated, before being allowed as debts against the company.

North Woolwich Telegraph Works Company, Limited.—Mr. Henry Alison, chairman, announces in *The London Gazette* of December 7th that, at an extraordinary general meeting of this company, held at 2, Tokenhouse Buildings, E.C., on Thursday, November 15th, and at a subsequent extraordinary general meeting held on Friday, November 30th, these special resolutions were passed and confirmed:—

"That the Company be wound up voluntarily;" and

"That George Fraser, of No. 2, Tokenhouse Buildings, London, E.C., Chartered Accountant, the Secretary of the Company, be appointed Liquidator of the Company for the purposes of such voluntary winding up."

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Lancashire and Cheshire Telephonic Exchange Company, Limited.—The annual return of this company, made up to the 20th of August, was filed on the 28th ult. The nominal capital is £300,000, in £1 shares; 296,161 shares have been allotted, and upon 260,000 of these the full amount has been called up and 10s. per share upon the remainder, the calls paid amounting to £296,077, leaving £84 unpaid. 36,161 shares have been issued since the filing of the last return. Registered office, 38, Faulkner Street, Manchester.

Electric Signal Company, Limited.—Upon terms of an agreement, dated 10th of October, and filed on 30th ult., this company will purchase the invention of Mr. James Enright, of West Kensington Park, electrician, for enabling observers to read thermometers and barometers, and to find the height of liquids in cisterns, boilers, vats, &c., at a distance from them, and to determine the position of a body in motion in a definite track, such as a train between two stations, and to enable the signalman and the driver to signal to one another. Letters Patent have been applied for in respect of the said invention, and provisional protection, dated 4th June, 1883, and numbered 2,759, has been granted. The consideration is £100 and 50 paid-up shares of £10 each.

Pall Mall Electric Association, Limited.—The annual return of this company, made up to the 31st October, was filed on the 1st ult. The nominal capital is £15,000, in £5 shares. 400 ordinary shares and 2,600 vendors' shares have been issued, and upon the former £2 10s. per share has been called, the latter being considered as fully paid. The calls paid amount to £1,000 and considered as paid to £13,000. Registered office, 21, Holborn Viaduct.

Lyons Electrical Power Storage Company, Limited.—The registered offices of the company have been removed from 3, Copthall Buildings to Mansion House Chambers, 11, Queen Victoria Street.

Ferranti, Thompson & Ince, Limited.—This Company's address is now changed from 3, Fenchurch Avenue, E.C., to 110, Cannon Street, E.C.

NEW COMPANIES REGISTERED.

Atlas Electric Appliances Company, Limited.—Capital £2,000, in £1 shares. Objects: To purchase the invention of J. R. P. Wallis and F. W. Cherry relating to improvements in electric lamps, for which provisional protection has been obtained. The purchase consideration is £25 cash and 40 fully paid preference shares, and 150 founders' shares. Signatories (with one share each): F. W. Cherry, 16, Limes Grove, Lewisham; J. R. P. Wallis, Distington, Cumberland; G. Adams, 138, St. Paul's Road, Camden Square; B. R. Wood, 36, Mildmay Road, N.; W. B. Davis, 105, Leadenhall Street; J. H. Robinson, 106, Leadenhall Street; H. N. Watson, 9, Ravensbourne Road, Bromley, Kent. The first directors are C. Tottenham, 9, Stratton Street, W.; Wm. Williams, 13 and 14, King Street, E.C., and J. S. Wood, 12 and 14, Southwark Street. Registered 1st inst. by Thos. Mee, 2, Great Winchester Street.

CITY NOTES, REPORTS, MEETINGS, &c.

The Swan United Electric Light Company, Limited.

A general meeting of the shareholders of this company was held on Tuesday, at the City Terminus Hotel, Cannon Street, Mr. James Staats Forbes, Chairman of the Board of Directors, presiding.

The first annual report, which was circulated amongst the shareholders, stated:—

The Directors are pleased to report that the expectations of profit from the sale of lamps have to a great extent been realised; during the thirteen months the sale of lamps has steadily increased, upwards of 180,000 have been sold, and the profit arising from these sales amounts to over £7,000. This would have been greater but for the amount expended upon a change in the type of

the lamps. The original pattern of the lamp, whilst adapted for isolated installations and for ship lighting, is not as well suited as lamps of higher resistance for district lighting.

It is, however, satisfactory to the Directors, in relation to this branch of their business, to be able to add that there has been a progressive improvement in the quality of the lamps, tending both to greater efficiency in lighting and greater economy in production.

Important additions have been made to the working plant at the Company's freehold factories at Newcastle.

Four Provisional Orders were obtained: the first and second for residential districts, one immediately surrounding and including the Victoria Railway Station; the other at South Kensington, in the neighbourhood of the Gloucester Road Station; a third for the Strand, including many of the Theatres and places of public amusement, and a fourth near Hanover Square, and including most of the best West End shops.

The company has already commenced works in connection with one order, viz., that having for its object the lighting of the Victoria Station. A substantial building has been erected; boilers and engines for upwards of 500 horse-power are partly in position; most of the wires have been run, and little remains to be done to start the lighting there. Further action in regard to the carrying out of the Provisional Orders obtained by the Company will now devolve on the new Board of the Edison and Swan Company.

In relation to the foreign business of the Company, the Directors regret to say that litigation has arisen on the Continent between this Company and the Continental and German Edison Companies. In France and Germany the Swan patents have been assailed by the Edison Companies, and in Austria, Belgium and Germany the Edison patents have been attacked by the Swan Company. The suits are in their earlier stages, but the Directors have the fullest confidence in the legality of their position, their action having been taken after very careful consideration and under the best foreign legal advice.

A balance of £4,000 will shortly fall due in respect of Spanish Patent Rights on the Foreign Patent Account.

The Profit and Loss Account of the British business for the thirteen months ending 30th June, 1883, shows a profit of £8,254 10s. 2d., which amount the Directors have appropriated in —Depreciation and reserve, £7,716 8s. 8d.; Balance carried forward, £538 1s. 6d., total, £8,254 10s. 2d.

The Profit and Loss Account of the Paris Factory shows a debit balance of £1,470 9s. 6d. This loss arises chiefly from the fact already referred to, that the Paris Factory has been hitherto exclusively limited to supplying lamps for use in France, the French Patent Law rendering it imperative that all lamps sold in France should be made in that country. The stimulus given to electric lighting on the Continent by recent exhibitions at Munich, Berlin and Vienna, has produced lately an increased demand for Swan lamps, and there seems every prospect of a large and remunerative business being conducted from the new factory at Lille.

The Secretary, Mr. J. H. Ivory, having read the notice convening the meeting,

The Chairman, after asking that the report might be taken as read, said: I want to call your attention to the fact that the accounts represent the transactions of the company for thirteen months. We had our statutory meeting, at which meeting, gentlemen rather expected me to say something on what perhaps would very soon arise, the amalgamation of the Swan and Edison Companies, and very recently we had a meeting in order to carry out an agreement to effect that object; and at both those meetings I was enabled to address the proprietors at some length on the general position, as well as to indicate some details of the business. This is a more interesting meeting, in one sense, because it is the period when for the first time we are called to present accounts and to explain, if called upon, the details of those accounts, to judge as far as we can, with your assistance, the probable outcrop of this new enterprise in which we are embarked. We have purposely made the report a little fully, and you will see that it divides itself almost naturally into three separate heads, for our business is carried on under three separate heads. First, there is the manufacture of lamps: everybody knows Mr. Swan's patent as a patent more especially having to do with the manufacture of that wonderful instrument, the Swan lamp. We are empowered also under our general articles to become, not only manufacturers of lamps, but erectors or suppliers of what are called installations; that means all the preliminary machinery antecedent to the use of the lamp. And another branch of our business, or rather another thing which we may do under our articles is the erection and carrying on of works for the general lighting of large districts. These are the three distinct heads, and I want to show, as a sort of preliminary note, that you must not assume that the results of the thirteen months' work as evidenced in these accounts have anything to do with but a very limited portion of the Company's business. We have, of course, been able to develope most of all the manufacture of lamps. When I say most of all, that is a very limited development compared with what there is a reasonable probability of its assuming in years to come. Immediately there will, I have no doubt, be a very large development, but that depends somewhat on the development of the other things. The erection of instalments: that means that a number of factories, theatres, detached buildings or other establishments, of which there are thousands in Great Britain, are sufficiently great consumers of light to justify the erection for themselves and their own purposes of this installation. Of course, that is a matter which must come slowly; the whole thing is so novel, the competition of gas companies, of course, is carried on under such advantages—people know what they have by gaslight, and, however eager to avail themselves of something better, a great many prefer to follow rather than to lead in these matters, and so there is a great deal of waiting to see. This is much more the case with the third head, the general lighting of large districts. It is quite impossible to do anything with that until companies are prepared to undertake it and have ascertained what their legal position would be. As long as we are on private property there is nothing to prevent us from doing as we like without being interfered with. But the moment we get into general lighting, that means interference with public rights, which cannot be interfered with without the authority of Parliament or some public tribunal. The last twelve months have been occupied in considering, first of all, this general lighting question, and in taking the measures necessary to learn what the Board of Trade, the authority primarily entrusted with the consideration of this question, and after that Parliament, would expect us to do, and the kind of limitation that would be imposed upon us. All that has been done. Thirteen months is not a very long time, when you look back upon it, for the working out of a matter of this sort; but our position is very different to what it was only a short thirteen months ago, when we took over from the old company the factory at Newcastle. There was a good deal to be done there, and we have done it, so that it is now capable of producing more, and, we believe, better work. With respect to installations, we have done something in that direction, and especially with steamships, which appear to be a very fruitful source of consumption of this electrical light machinery. This is a business not only being perfected by experience, but, no doubt, growing very rapidly. With respect to public lighting, we have our Provisional Orders; but we have thought it prudent not to do things in a hurry, nor more than we clearly saw our way to doing. The thing is quite crude as yet, and in its infancy; there is a great deal to be done to make it an absolutely certain and paying machine. We have been most anxious to go prudently, and not too rapidly, because these undertakings involve serious money responsibilities, and we have not thought it desirable in your interest to enter upon them without a great deal of caution. However, we have done it, and our business at this moment consists of manufacturing lamps, which are from time to time improved; detached installations of electric light apparatus; and the erection and carrying on of works for the general lighting of large districts. Notwithstanding the very small quantity of lamps sold, there has been a considerable profit. I have no doubt whatever, that assuming these patents to be maintained, as we believe they will be, and assuming the consumption of those lamps to grow very rapidly, as we believe it will, then we have got two factors quite ascertained, namely, that the lamp can be produced at a price which, consistent with the very low charge to the public, will leave us fair, I may say the usual, trade profit upon its production. Therefore, so far as the capital of the company is invested in lamp work, I look upon that, and my colleagues, I am sure, agree with me, as merely a question of time. Our position is not damaged—on the contrary it is much strengthened—by the fact that whatever merits the Edison patents have, we now possess them, and whereas it was debatable —might have been debatable, at all events—as to whether Mr. Edison did not infringe Mr. Swan's patent, or whether Mr. Swan did not infringe Mr. Edison's, what appears to be perfectly certain is, that Mr. Swan and Mr. Edison together are invulnerable, and will be a terror to evildoers in the shape of infringers; and should these wonderful inventions be infringed, we will do our best to vindicate our claim to have the benefit of them, at all events, for that limited time for which patents ensure them. Detached installations: this is a much more complicated question and involves considerations of a financial kind, and you will easily understand that when I tell you that an installation means, first of all, the manufacture of an engine to drive a machine. Plenty of people make engines to drive machines; but these engines are certainly peculiar. No doubt, in time, people will be found to make them for tender at very moderate profits, and therefore it is a consideration whether these companies, like the Edison and Swan United, need involve themselves in the financial responsibilities of starting a factory to make engines. The dynamo stands upon rather a different footing, and, although somewhat more novel than an engine, a great many heads are engaged upon it. It may arise that we may not have to become manufacturers of dynamos; it may arise that we shall have to. We are hardly yet in a position, I think, to decide that. But, of course, what we do want to avoid is to put our hands into our pockets, to spend large sums in founding factories when we can find other people to give their capital, use their brains, and give us what we want at moderate trade profits. That applies even more positively to what is called public lighting. That is the thing behind the other parts of the business, and is certainly much more complicated than anything else we have to deal with. I think we shall find a great number of people willing to put their capital in to work out these difficult problems in different parts of London, and if we are sure, as I think we are, of the lamp, then we shall enjoy the benefit of their capital and work. These are the elements out of which we have to work a business. It does not very much affect the proceedings of the last thirteen months more than this, that in conducting this Swan business we have learnt a good deal. Referring to the Provisional Orders obtained, Mr. Forbes said, alluding particularly to the lighting of Victoria Station: I confess it seemed to me very desirable to establish one or two things, such as whether the incandescent lamp would light

up a complicated building such as a great London railway station; if so, it will be a standing advertisement for us of the greatest value. One or two other things it is vital should be solved. To know what we are spending to obtain a result, and to know what we are to receive as payment for that result, and to be able, by a little care and analysis, to know how far one fits the other. Continuing to speak upon the advantages of the fusion of the two companies, the chairman remarked that it was probable the litigation in reference to the foreign patents would shortly arrive at a satisfactory settlement, and then said the profits of the company would have been much larger but for the fact that the whole of the expenses of the negotiations and other matters had been charged against the year's working; whereas the clearing off of many of the items might have been extended over a series of years. He believed they had now attained all the means necessary for doing a large business whenever it should present itself. There had been a loss of £1,470 on the Paris factory; this really arose from the fact that it was quite unwise to press the business at Paris. They were obliged, in order to conform to the French Patent Law, to start a factory, or else their patents would have been annulled; but there were reasons of a very good kind which made it inexpedient to press that business with any degree of vigour. He was not at liberty at that moment to enlarge on the fusion of their interests with those of the Edison Company, but he was perfectly satisfied that the policy of playing a waiting game had placed them at a considerable advantage against others who had not waited, but had spent money in trying to get a start of them. He begged, in conclusion, to move the adoption of the report.

Major-General Trevor seconded the resolution.

Mr. Erdmann remarked upon what he termed the enormous sum of £30,135 8s. 9d. set down as for salaries, wages, rent and general expenses, which was nearly 55 per cent. of the capital employed in the manufacturing business.

The Chairman said he thought he had explained that the £30,000 included, not only the cost of conducting the establishments involving manufacture, but also all the general charges of the Company. It included the director's fees, a little over £2,000 in each instance, and this was a beggarly pittance for the responsibility and labour they had had. Would anyone challenge that? It included also rent, rates and taxes, the cost of advertising, printing and stationery, the weekly wages of the glass blowers, carbon and filament makers in the employ of the company, and a great variety of other people. He might tell them this was quite a new business, and they had not only to invent the thing as a philosophical implement, but to manufacture also the people to manufacture it.

A Shareholder: But we were to have bought a complete thing.

The Chairman: No; you bought the thing as it then was—an avowedly experimental thing. I cannot imagine that anyone can believe they had bought a complete thing.

A Shareholder desired to know if they would always have to wait six months before the accounts were presented after the general meeting of the company.

The Chairman said, he did not think there was any need. But some people seemed to think it was a very easy matter to get the accounts into shape; they had no idea of what was mixed up in it. Some accounts could have been presented on the 30th June, but it was not thought desirable to present them. Now they had the whole machinery for carrying on the company, and in future there would be no reascn for waiting. They were now to be merged into another company, and their accounts would depend in future upon when the Edison company saw their way clear to make up their accounts. But they would have, for some time yet, to go on as a separate company. In reply to a further question, the Chairman said, if installations were undertaken it would be necessary to make one or two calls upon the shareholders, as the company had not at present a great amount of spare cash, and they could not carry on the business without sinking money in it. Reasonable notice, about a month, perhaps, would, however, be given.

Mr. Walter Gay asked, if a statement in the report of the Eastern Electric Light Company to the effect that that company had the exclusive right of the Swan lamp in certain portions of India, were correct.

Mr. Swan: I think I may say that the paragraph has a grain of truth in it, inasmuch as there is a contract existing between this and the Oriental Company respecting lamps, but not a contract binding this company—it is one of a very limited character, but on the whole profitable.

The retiring directors, Mr. J. S. Forbes (chairman), and Mr. E. W. Batt, were then re-elected; as also were Messrs. Quilter, Ball & Co., as auditors, this terminating the proceedings.

The Metropolitan (Brush) Electric Light and Power Company, Limited.

THE report of the directors, to be submitted to the shareholders at the first ordinary general meeting, to be held at the City Terminus Hotel, Cannon Street, on Monday next, states that the delay in presenting their first annual report has been occasioned by the difficulties they experienced in the conduct of important negociations, which, however, have at length been brought to a successful issue.

Your company having acquired from the Hammond Electric Light and Power Supply Company, Limited, a lighting station in High Holborn, together with a staff of travellers—afterwards augmented—for procuring orders, lost no time in securing all the business obtainable in that neighbourhood. They also opened four other lighting stations in populous districts, where the probable demand justified the expectations of profitable results, viz: in Milford Lane, Strand; Old Swan Lane, City; Nursery Road, Brixton; and Mint Street, Borough. In all these districts a vigorous canvass was prosecuted; but as the work progressed two powerful causes came into operation against them—first, the want of legal powers; secondly, the want of a complete system for incandescent lighting, which was chiefly in demand.

Your directors regret to state that the results of the operations of the company for the 13 months ending 30th June last, show a loss as per balance sheet of £14,927 9s. 11d. In arriving at this amount, however, the most ample deduction has been made for depreciation of plant in connection with the Old Swan Lane and Mint Street stations, which are now closed, and with the Nursery Road, Brixton, which has been handed over to a local combination, and for the unrealizable capital expended in their construction. A suitable amount has also been written off on account of the Holborn and Milford Lane stations, and the stock of dynamos, lamps, cables, &c., on hand has been re-valued and taken at current market prices, but no amount has been written off the sum paid for the concessions.

The passing of "The Electric Lighting Act, 1882," with its practical prohibition against the system of overhead wires, caused agitation against its alleged dangers, and several local authorities threatened to apply for injunctions against the company, and in one instance the threat was carried out. From this and other causes the volume of business of the class that had hitherto freely offered gradually diminished—intending consumers holding aloof in the early prospect of obtaining the current through street mains from central stations, and in constant supply, on more advantageous terms than were possible for isolated lamps or separate installations. As, therefore, your directors found themselves hampered in carrying on business by means of overhead wires, and were not in possession of powers to place mains below ground, it was necessary to apply to Parliament for such powers, and so successful were these applications that Provisional Orders, confirmed by special Acts of Parliament, have been secured, conferring on the company the right to open up streets and supply electricity in no fewer than 23 metropolitan districts. The magnitude and value of these concessions may be estimated when it is mentioned that they cover an area of about 28 square miles in some of the most important districts of the metropolis.

When the company commenced business, your directors had only the Brush and Lane-Fox patents to depend upon. The Brush patents, though admirably suited for arc lighting, and certain other purposes, did not provide what was desired for house to house incandescent lighting, and it was also found that being tied to one system operated against your company at the Board of Trade, and was likely to operate still further against it in working under its Parliamentary Powers. Your directors, therefore, found it necessary to endeavour to obtain a release from the restrictive clauses of your licenses, and lengthened negociations carried on with this object have now been concluded, and an arrangement entered into which is briefly to the effect that this company is released from the restrictive clauses binding it exclusively to use Brush and Lane-Fox apparatus. Under this arrangement the Brush Corporation is permitted to do business in your district, but only on the condition that they pay this company royalty on the sale or hire of electric machines or appliances.

The possession of the above-mentioned Parliamentary Powers places your company manifestly in the very first rank of electric lighting companies. In exercising these powers your directors, however, propose to proceed with great caution, and in the first place to take in hand the Holborn district, owing to the company possessing a station there, and for other good and sufficient reasons. A house to house canvass has resulted in a very general expression of desire on the part of the residents to adopt our light upon terms which, according to the estimates specially prepared, show a very satisfactory return on the proposed capital outlay.

The shareholders will in due course be informed of the result of this work, which will be a good and safe guide to your directors as regards the best method of dealing with the further Provisional Orders. To carry out the proposed installation in the "specified streets" of the Holborn district, an expenditure is required which is within the available paid-up capital of the company. The directors have now under consideration overtures made to them for the carrying out of some of their orders through the medium of capital to be provided outside the company.

In dealing with the work required by the Provisional Orders, the best practical technical aid and organisation that can be obtained, is needed, and, in order to secure this, your directors have concluded an advantageous arrangement with the Hammond Electric Light and Power Supply Company, Limited (who have extensive manufacturing works and a thoroughly equipped organisation) whereby all the Metropolitan electric lighting work of both companies will be carried out by the Hammond Company at prime cost, and at their own risk as regards possible loss, each company taking an equal share of profits, and this company being entitled to prescribe the plan or system on which any work for which it finds the capital may be carried out, the position of the Hammond company being that of contractors.

Your directors felt called upon to institute a searching examination into all the circumstances connected with the formation of the company, and have taken separate opinions of two leading Counsel—the Solicitor-General, and Mr. Romer, Q.C.—upon cases prepared by wholly independent solicitors, but as the result of such opinions, and on grounds of general expediency, your

directors have considered it in your interests to enter into the agreement already mentioned with the Anglo-American Brush Electric Light Corporation, which, while giving to this company freedom of action, also secures to it a favourable settlement of all money claims between the two companies, and liberal royalties, not only on all business done in the Metropolitan area by the Brush Corporation, in sales or on rental of the electric machines comprised in the Brush and Lane-Fox licenses, but also royalties on all other similar machines sold or rented by the Brush Corporation within your district to which this company had previously no claim. This appears to your directors to be a very substantial concession in settlement of any claims that this company might possibly have on the Brush Corporation; the agreement, however, will not be proceeded with unless the policy of your directors be approved.

The position of this company is therefore now as follows:—It has an unexampled field of operations—freedom to use any system of lighting or of producing electric power, with a right to royalties on business done by the Brush Corporation—and a good and efficient agency in the Hammond Company for carrying out their practical work on very favourable terms. It is not too much to say that the first company which successfully carries out house to house lighting in the Metropolis, will acquire a position, the importance and value of which it is impossible to over-estimate, nor that, notwithstanding the disappointments of the past year, this company is now within reach of attaining to such a commanding position.

There are upwards of 1,600 shareholders in your company, fourteen of whom have instituted legal proceedings to have amounts paid by them returned, on different grounds. These proceedings have already entailed heavy expenses on your company, but your directors rely with confidence on eminent legal opinions, and on the decision of Mr. Justice Chitty, who remarked in the course of the judgment given by him in the only case that has been tried, and which resulted successfully to the company,—"I see no fair ground for attacking this prospectus."

Your directors regret to state that they have found it necessary to dismiss the late manager, Mr. Keatinge Pollock: that gentleman—being the paid officer of the company and in a highly confidential position—had taken part in the preliminaries to, and had attended, a private meeting of some shareholders, and had there, without informing your directors of his intention, and without previously resigning his office as manager, communicated private affairs of the company, with a view to organising an opposition to the policy of your directors; a proceeding which rendered it impossible for your directors to hold any further official communication with him, or to permit him to have access to their deliberations or proceedings. For some time previously to his dismissal the late manager strongly and persistently urged your directors to adopt a course of action that would have plunged your affairs into protracted litigation, which your directors were advised by the above-named most eminent counsel could not be entered upon with any good prospect of ultimate success, but which, if once embarked on, would have paralysed the efforts of the Board to carry on the company's business. The action of Mr. Pollock renders these explanations unavoidable, although the directors deplore the necessity of thus turning aside from the all-important concerns of the company, at a time when it is of the first importance that the credit and reputation of the company should remain unimpaired, in view of the important negociations to be entered upon with public and private bodies throughout the Metropolis.

The Board has been strengthened by the accession of gentlemen possessing technical skill and business ability, and your directors hold upwards of 8,000 shares in the capital of the company.

The cost of the official staff, general charges, office rent, &c., has been reduced to about one-third of the former amount.

The balance-sheet of the company to 30th June, 1883, is as follows:—

To capital authorised, 200,000 shares, of £5 each, £1,000,000; Capital issued (£497,770, less uncalled, £2 per share, £199,108 and calls in arrear, £1,112 10s., £200,220 10s.), £297,549 10s.; sundry creditors, £4,875 4s. 10d. Total £302,424 14s. 10d. By purchase of concessions, &c., deducting estimated value of plant, carried to separate account, £233,116 7s. 2d.; plant, machinery, cable, and fittings at lighting stations and on customers' premises (including Brixton building and less depreciation, £2,148 1s.), £8,071 13s. 9d; cost of special installations (less depreciation £871 5s. 10d.), £2,390 7s. 5d.; office furniture (less depreciation), £584 7s.; stocks on hand at date, valued at current prices, £5,741 11s. 10d.; expenses of obtaining Provisional Orders, £6,921 14s. 2d.; sundry debtors, £2,187 11s. 9d.; cash at bankers on deposit and current account and in hand, £28,483 11s. 10d.; profit and loss, as per account, £14,927 9s. 11d. Total £302,424 14s. 10d.

Profit and loss account, 30th June, 1883. Dr. To wages, stores, rents of stations, &c., £6,466 11s. 8d.; salaries, £3,484 8s. 1d.; directors' fees, £2,241 1s. 11d.; rents, rates and taxes, £779 2s. 1d.; printing and stationery, £623 7s. 7d.; general trade charges, advertising and office expenses, £919 4s. 4d.; expenses of canvassing, £1,369 3s. 6d.; insurance, £105 8s. 11d.; way leaves, £56 13s.; law charges, £1,115 4s.; bad debts, £50 3s. 4d.; depreciation on plant, machinery, stocks, &c., £3,706 5s. 11d. Total, £20,916 14s. 4d. Cr. By rentals, viz., general consumers, £1,952 5s. 3d.; special installations, £1,486 15s. 10d.; profit on sundry sales, £816 12s. 9d.; interest on deposit, and discounts, &c., £1,579 5s. 1d.; transfer fees, £154 5s. 6d.; balance, being loss, £14,927 9s. 11d. Total, £20,916 14s. 4d.

The Eastern Electric Light and Power Company, Limited.

The report of the directors, presented at the second ordinary general meeting of the company, held at the Terminus Hotel, Cannon Street, yesterday, is before us, and, as there is no profit and loss account rendered, we cannot do better than take the directors' *précis* of it as it is given at the end of the said report. It runs thus:—

"In conclusion, the directors would briefly allude to the causes which have been most prejudicial to the prosperity of the company.

"1. The action of the Indian Government in prohibiting overhead wires. This alone was sufficient to paralyse all efforts at progress, the consequence of the order being, exasperating delays, greatly increased difficulties in practical working, and profitless heavy additions to expenditure.

"2. The general collapse in prices of shares in electric light undertakings. This could not be without its effect in India, and combined with the order of the Government, and the warning given as to the danger of exposed conductors occasioned alarm and suspicions that will only disappear with time.

"3. The non-realization of the expectations that had been formed as to contracts for works, and sales of plant, and a consequent locking up of capital in machinery and plant still unemployed.

"4. The imperfect knowledge possessed by the mechanical electricians and engineers that were available in the early period of the company's work. The extreme difficulty of securing competent men, and the incomplete state of the electric lighting industry generally, caused many unforeseen failures, and introduced an element of great uncertainty in the framing of estimates."

Appended to the said report appears the following:—

"TO THE EASTERN ELECTRIC LIGHT AND POWER COMPANY, LIMITED.

"Gentlemen,—We have examined the balance sheet submitted to our audit, to 30th September, 1883, and we beg your attention to the following remarks:—

"The accounts from abroad are very imperfect and not fully vouched, and no record of trading has reached London which would enable your staff to submit to you a profit and loss account showing the result of the transactions to the above date.

"No valuations of machinery, stores, &c., issued in carrying out the various installations, nor of the stocks remaining in hand on 30th September have been submitted to us.

"We can only report to you that the total of £97,382 2s. 10d. must be taken as the amount of the expenditure of the company, but is subject to the value of any land, buildings, machinery, plant and stores, belonging to the company on the date of closing the accounts.

"We believe that, having regard to the absence of these particulars, the best has been done in the account herewith, to represent the proceedings and condition of the company.

"Yours faithfully,

"DELOITTE, DEVER, GRIFFITHS & Co."

Birmingham and Warwickshire Brush Electric Light and Power Company, Limited.

AN extraordinary general meeting of this company was held on Friday, the 7th instant, at the Cannon Street Hotel, Mr. Robert Hammond in the chair, to consider a resolution winding up the company. The Chairman said it was unnecessary to recapitulate what was brought before them at the last meeting. The amalgamation agreement had been practically carried out. The assets of the company had been handed over to the Hammond Company, who had allotted the shares. He concluded by moving the resolution, which was carried, and a further resolution was then passed appointing Mr. Latham, of 110, Cannon Street, as liquidator.

Yorkshire Brush Electric Light and Power Company.

AN extraordinary general meeting of this company was held on Monday at the Cannon Street Hotel. Mr. H. Lowe presided, and stated that the meeting had been rendered necessary by the Companies' Acts, but the whole of the matter had been fully laid before them at the last meeting. He then moved a resolution to the effect that it was desirable that the company should be wound up voluntarily. The motion was carried unanimously, as was a further resolution appointing Mr. Philip A. Latham as liquidator, and to take such steps as might still remain necessary to carry out the agreement of October 23rd, between the company and the Hammond Company.

Anglo-American Brush Electric Light Corporation, Limited.—Mr. Edward Woods, vice-president of the Institute of Civil Engineers, has joined the board of this corporation.

Brazilian Submarine Telegraph Company, Limited.—The directors have declared an interim dividend of 3s. per share, or 6 per cent. per annum, free of income-tax, for the quarter ended September 30 last, and payable on the 22nd instant.

United Telephone Company, Limited.—The directors have resolved that an interim dividend at the rate of 5 per cent. per annum be paid out of the profits of the half-year ending 31st October last, and that the warrants be posted to the shareholders on the 8th proximo, accompanied by a statement of the business and progress of the company. The company have removed from Coleman Street to their new head offices at Oxford Court, opposite Cannon Street railway station.

TRAFFIC RECEIPTS.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending November 30th, amounted to £9,700.

The Great Northern Telegraph Company. The receipts in November were £21,480. From January 1st to November 30th, 1883, the returns showed receipt of £236,850; the amount for the corresponding months of 1882 being £225,863, and of 1881, £218,291.

The Western and Brazilian Telegraph Company, Limited. The receipts for the three days, after repair of the Brazilian Submarine Company's Cable, ending 7th December, were £1,303, after deducting the "fifth" of the gross receipts payable to The London Platino-Brazilian Telegraph Company, Limited. The Brazilian Submarine Company's cable being now repaired, the weekly publication of traffic will be resumed.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the three days ended 7th December, amounted to £1,615.

PROCEEDINGS OF SOCIETIES.

Physical Society, December 8th, 1883.

Prof. G. CAREY FOSTER in the Chair.

New Members:—Major McGregor, R.E.; Mr. James Walker, M.A.; Mr. W. B. Gregory, B.A.

Prof. SILVANUS P. THOMPSON, D.Sc., &c., read a paper "On the Static Induction Telephone as an Instrument of Research." The author had employed Dolbear's telephone in investigating the action of influence machines such as those of Holtz and Wimshurst or Toepler. This was done by holding the end of a wire (connected to one terminal of the telephone) near the electrified parts of the machine, for example the "carriers" in the Toepler apparatus. The carriers induced a charge in the telephone, whose other terminal was to earth; as they passed, and the pitch of the note heard in the telephone increased with the speed at which the machine was driven, useful results were obtained, leading to modifications of some machines. The same telephone was also applied to the measurement of capacities of condensers, arranged like the resistances of a Wheatstone balance, and the telephone taking the place of a galvanometer. For the "divided coil" of the balance Prof. Thompson substituted a double condenser, or rather, two condensers so joined that the earth plates were separate, while the other plates were in one. This device was made from two glass tubes, with tinfoil round their outsides, and a brass tube sliding into both interiors in such a way that the relative capacities of the two condensers thus combined could be altered by sliding the tube between them. A modification of this plan was suggested by Mr. Starling, the author's assistant, which was analogous to Prof. Foster's arrangement of the Wheatstone balance, that is to say, six condensers were used, the two extra ones being included between the battery connections and the sliding tube. The battery was in this case an induction coil having no condenser, as a discontinuous current is necessary to give sounds. The author also showed that the Dolbear telephone could be used instead of the quadrant electrometer in such experiments as those of Mr. J. E. H. Gordon on specific inductive capacity. The author also showed how he had applied it to explore the equipotential surfaces round conductors charged statically by an induction current. With two wires from the terminals of a telephone silence is produced when both ends are in the same equipotential surface, and sounds when they are not.

Prof. THOMPSON then read a "Note on a new Insulating Stem." This consisted of a glass tube, with one end blown into a flat foot, which was planted on the bottom of a glass bottle, and cemented there by a little wax paraffin. The upper and open end of the tube served to hold the stems of brass plates for other electrified bodies. Paraffin oil or strong sulphuric acid could be used in the bottom of the bottle. A cap of rubber or percha made to slide up the stem served as a dust cover.

Prof. THOMPSON next made a communication "On the First Law of Electrostatics," and illustrated his remarks with experiments, showing how a series of floating magnet-poles of like name repelling one another tend to produce equal distribution of the poles. Prof. Thompson, arguing from the second law of electrostatics (inverse squares), sought to explain the first law in a rational manner, on the hypothesis of self-repelling molecules, which tend to uniform distribution. When there is a surplus in one part and a deficit in another the molecules are urged towards each other, *i.e.*, attract. This was shown by putting a surplus of floating magnets at one part of the basin. By the movements of these magnets, when confined in barriers and with surplus and deficit purposely made, the author imitated the effects of a Leyden jar, induction, a battery current, &c., the motions and arrangement of the poles illustrating the hypothetical behaviour of electricity. The author was led by the hypothesis to infer that either the ether is electricity or that the ether is electrified, and the former seemed the simpler conclusion.

Dr. MONKMAN showed some "Experiments illustrating the Attraction and Repulsion of Bodies in Motion." The attraction of a light balanced body to a vibrating tuning-fork was shown; also the attraction between two discs of paper revolving parallel and in the same direction. The author showed that two smoke-rings travelling abreast in the same direction attracted each other, and that two paper rings revolving in the same direction close together attract, while if revolving in the other direction they repel.

Mr. WALTER BAILY exhibited his new "Integrating Anemometer" in action by means of a small electric motor, which took the place of the Robinson cups. The apparatus sums up or integrates the wind velocities on the lines of the four cardinal points. An electric counter is attached.

NEW PATENTS—1883.

5668. "Improvements in electric apparatus for automatically operating fog signals on railways and in percussion caps or detonators to be used with such signals, which improvements are also applicable to blasting apparatus and torpedoes." G. W. v. NAWROCKI. (Communicated by Dreyse & Collenbusch.) Dated December 7.

5680. "Accumulators for storing electrical energy, applicable also to primary batteries." J. GREENWOOD. Dated December 8.

5682. "Magnets and dynamo-electric machines with continuous currents." A. DE MEURON, H. CUENOD. Dated December 8.

5708. "Improvements in the method or process for insulating electric conductors and improved manufacture of composition therefor." A. J. BOULT. (Communicated by J. B. Hyde.) Dated December 11.

5714. "Electric lighting apparatus for use in certain surgical operations, for personal ornament and for theatrical and decorative purposes." A. M. CLARK. (Communicated by G. Trouvé.) Dated December 11.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

1575. "Electro-magnetic printing telegraph apparatus." W. P. THOMPSON. (A communication from H. Van Hoevenbergh, of America.) Dated March 28. 8d. The principal object of the invention is to secure increased rapidity of operation. To this end it is sought to reduce to a minimum the number of mechanical operations performed by the apparatus at the receiving station; thus the type-wheel is caused to advance normally through successive arcs each subtending two characters, or in other words, so as to skip one character at each step. When any one of the characters thus skipped is to be printed, the wheel is arrested on arriving at the character next in advance of the required character, and a device is brought into action which mechanically advances the wheel through an arc subtending one character. This brings the required character into exact position, and the impression is then taken therefrom. The invention further includes a transmitting mechanism for operating the improved apparatus at the receiving station, thus completing a system both simple in construction and rapid in operation.

1646. "Construction of incandescent electric lamps and fittings employed therein." J. L. HUBER. Dated April 2. 4d. Relates to improvements in appliances for electric lighting which serve to hold the incandescent lamps, and to connect their carbons with the conducting wires; and the objects of these improvements are—first, to enclose the conducting parts entirely inside the non-conducting holder, in order to protect the conducting parts from coming accidentally into contact; and, second, to obtain an elastic connection between the holder and the lamp. (*Provisional only.*)

1647. "Electrical safety plugs or fuses." C. V. BOYS and H. H. CUNYNGHAME. Dated April 2. 6d. Relates to electrical safety plugs or fuses, that is to say, portions of an electrical circuit which shall give way and open the circuit whenever a current beyond the normal strength passes through them. The object of the invention is to construct such safety plugs or fuses in a simple and compact form, and in such a manner that they will immediately act whenever the current becomes too powerful, and that after one has acted, a fresh plug or fuse can be readily substituted for it. For this purpose the inventors make the plug or fuse in two parts, of metal in the form of thin strip or wire, and they unite these two parts by soft solder, taking care to make the junction of small extent. They fix the two ends of the plug thus made so as to connect two points of the circuit to which it is to be applied, securing it by screws or by merely pushing its ends tightly into holes or slits in suitable terminals, and they apply to the plug or fuse a spring or springs, so as to put a strain on the junction. These springs may be separate from the plug, and may be attached to the terminals which it joins, or the plug itself may be so bent or twisted before being fixed in position, that its own elasticity imposes on the junction the required strain. When an excess of current passes through the plug, the junction becomes heated and the solder gives way, permitting the two limbs of the plug to fly apart in obedience to the springs or to their elasticity, and so opening the circuit.

1652. "Electric safety lamps." T. COAD. Dated April 2. 2d. The inventor employs an incandescent electric lamp enclosed within a glass casing or lantern as hitherto. The said casing he then fills with water impregnated with carbonic acid gas under pressure. In a suitable position in the lamp casing he provides a flexible

disc (or equivalent means) to which is attached a contact piece in such a manner that the pressure within the casing will cause contact to be made so as to establish the electric circuit. If the casing be broken the gas and liquid contained therein will escape, the interior pressure will be removed, and the circuit will be immediately broken, and the lamp extinguished. Should the lamp globe also be broken simultaneously with the outer casing no danger would result. *(Provisional only).*

1684. "Electric lamps or lighting apparatus." E. LUMLEY. Dated April 4. 2d. Consists of an electric vacuum lamp in which the carbon conductor is secured into flattened and spirally-coiled ends of the metallic conducting-wires and cemented thereto. *(Provisional only).*

1704. "Appliances for conducting and controlling electric currents." J. M. M. MUNRO. Dated April 5. 6d. Has for its object to provide improved safer and otherwise better appliances than those hitherto in use for conducting and controlling electric currents. It consists in making one of the conductors hollow or tubular, and in using it as a cover and protection for the other conductor which, with an insulating coating, is to be passed through it.

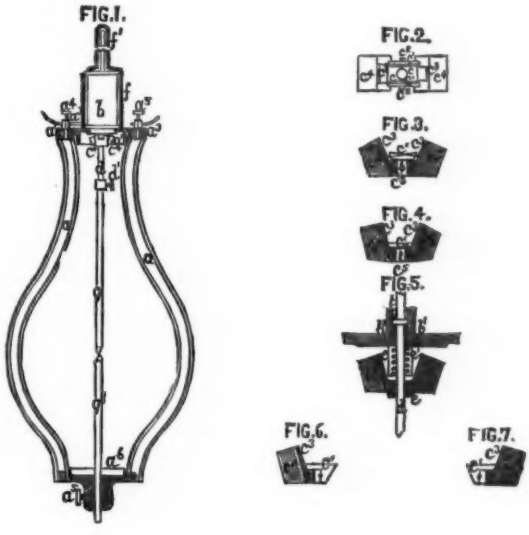
1710. "Apparatus for generating and promoting electric and chemical action, &c." S. J. WALLACE. Dated April 5. 2d. Consists in improved apparatus and processes for generating and promoting electric and chemical action by electro-chemical means, and for producing various products of such action and of electrolysis, in which the inventor uses several features known in the arts and patents, and especially in "gas" and other "batteries," electro-chemical, gas, and chemical apparatus and processes, together with others which are new.

1736. "Dynamo-electric machines of Pacinotti's sort." MARCEL DEPREZ. Dated April 6. 6d. Consists in making the iron of the ring in two parts and in manufacturing separately and apart by means of moulds the coils or sections of wire which are to be placed on the ring. The coils having been made they are slipped or passed upon the two parts of which the ring is composed, and the two parts are then connected so as to form a whole which presents no projection, no solution of continuity in a magnetic point of view. Lastly, the inventor covers the gaps which remain at the points of junction, either by applying coils or sections thereto in the ordinary way or by opening out a little the coils or sections already on the ring.

1737. "Apparatus for transforming electric currents." MARCEL DEPREZ. Dated April 6. 6d. Consists in forming with the accumulators a continuous transforming apparatus, receiving the current in one form and giving it off at the same time in another determined form with the least possible loss of energy. For this purpose the inventor places on the generator circuit a suitable number of elements of some accumulator, arranged either in a single series or in several parallel series supplied in derivation. In a system of this kind by arranging the branching points of a derivation in such manner that they comprise between them a determined group of elements in tension, the current will be produced in this derivation by virtue of an electromotive force equal to that of the elements of the accumulator thus put into play, increased only to an unimportant amount arising from the derivation of the generator current. This derived current will therefore be of as low a tension as is desired, and its intensity depending only upon the resistance of its circuit, will be arbitrarily determined. But its duration will only be the time employed in discharging the accumulator elements put into action; these having been discharged it will be necessary to pass to another group, and we will thus have a continuous current under the single condition that the elements shall have time to be recharged before they are again put into action. The derivation will therefore be practically operated by means of two moveable contacts comprising between them a certain number of accumulator elements, these contacts having a movement which is either continuous or regularly intermittent, and travelling over the series of the poles of the accumulators with a suitable speed.

1745. "Electric lamps and appliances connected therewith." F. H. VARLEY. Dated April 6. 6d. Relates to the apparatus described in the number of the ELECTRICAL REVIEW for this week.

1753. "Electric arc lamps." (Communicated from abroad by J. R. Finney, of America.) Dated April 7. 6d. Fig. 1 is an elevation partly in section, and figs. 2 to 7 detail views of one form of the improved lamp. The lamp has a frame composed of two arms, a, a, connected at the top and bottom by cross-pieces, a^1, a^2, preferably of disc form. The upper disc, a^1, is insulated from the arms, a, by collars, a^3, of insulating material, and is provided with binding posts, a^4, a^5, for the attachment of the conducting wires, n and p. On the upper side of the disc, a^1, is an annular or hollow core electro-magnet, b, the bore of which is lined with tubes, b^1, of diamagnetic material, of sufficient diameter to permit the easy passage of the feed rod, d, of the movable electrode of the lamp. The core, b^2, of the magnet extends through the disc, a^1. Fastened to the under side of the latter is a flat strap or support, e, the end of which is bent at a right angle and is perforated for the passage of the feed rod, d. Resting on the support, e, is a pair of grippers, the jaws, c, of which are pivotted together by means of side plates, c^1, and pins or pivots, c^2. Each jaw has an arm, c^3, to which is fastened an armature, c^4. The meeting edges of the jaws are slightly bevelled at one side of the pivots, as shown at c^5, to permit them to have a slight radial movement. This is illustrated in figs. 3 and 4, fig. 3 showing the jaws open and fig. 4 closed, as when gripping the feed rod. The electro-magnet, b, is provided with a cap or cover, f, which has a tubular extension, f^1, to cover the feed rod, d, and of sufficient length to permit its vertical movement. One end of the coil of the magnet terminates at the core, and the other in the binding post, a^3, which is insulated from the frame. The lower disc, a^2, is perforated for the passage of the lower carbon or electrode, which is secured therein by means of a set screw, a^5. The lower disc, a^1, is provided with a shade holder, a^6, and the upper disc with a retaining flange, a^7. The carbons or electrodes are shown at g, g^1, the upper one being secured to the rod, d, by means of socket and set screw, d^1. A chimney-shaped shade is used, which is put in place by removing the lower carbon and then passing the shade up around the upper carbon and into the retaining flange, a^7, until it will slip over the edge of the shade holder, a^6, into place. Then the lower carbon is replaced from below. The circuit wires, n and p are connected with the corresponding poles of a dynamo-electric machine or other source of electricity. The circuit is by the wire, p, electro-magnet, b, rod, d, electrodes, g, g^1, frame, a, and wire, n, back to the generator. When the core, b^2, of the magnet becomes magnetised by the passage of the current through its coils, the armatures, c^4, are



drawn inwards radially until the jaws, c, grip the rod, d, and then they are drawn or attracted upwards carrying with them the rod, whereby an axial movement is given to the rod, and the points of the carbons are separated sufficiently to form the arc. When the core becomes partially demagnetised by the burning off of the electrodes, the grippers gradually descend and sink outwards radially until the rod slips downwards between them and fully re-establishes the circuit. The core becoming then fully magnetised again attracts the armatures, thereby causing the grippers to sieze and raise the rod. The feeding device just described is very sensitive and causes the lamp to burn with great smoothness and freedom from violent pulsations. The radial movements of the jaws being just sufficient to grip and release the rod, are very slight, the slight bevels, c^5, being amply sufficient to permit such movement. The extent of the axial movement depends on the size of the arc desired, and may be limited by the distance left between the upper ends of the armatures and the lower end of the core of the magnet. The power of the attraction of the magnet increases as the armatures are raised. In order to equalise this and prevent the formation of too great an arc, which would produce a violent pulsation of the light, at the instant the feed occurred, a spring, e^1, is provided under the third part of the proper tension to overcome or equalise the force of the attraction of the magnet at any given point, and thereby regulate the length of the arc.

1754. "Electrodes for electrolytic and like purposes." F. E. ELMORE. Dated April 7. 6d. The inventor incloses the anode in or surrounds it with a covering or envelope of porous material, such as flannel asbestos, porous clay, or other suitable material, whereby all the residues are retained in the said casing, and prevented from wandering about in the solution.

1759. "Apparatus for the production and regulation of the electric light and power." T. WIESENDANGER. Dated April 7. 4d. Relates, firstly, to dynamo machines or generators of electric energy and electro-motors, and, secondly, to electric regulator arc lamps. *(Provisional only.)*

1760. "Appliance for feeding the carbons of electric arc lamps." J. HENRY and H. B. BOURNE. Dated April 7. 6d. The invention is based upon the principle that by a gentle tapping or rapping at the side of a tube, a rod within, and just fitting it, can be caused to fall gradually and in proportion to the force exerted and the rapidity of action, coupled with the weight of the tube and its

contents. For the purposes of the invention the inventors fit or arrange a magnet and a spring armature close to the tube or rod which carries, say, the upper carbon of an electric arc lamp, said spring armature being of the required length, and provided with a button or knob to knock against the carbon-supporting rod or tube at each pulsation of the armature produced by the flow of the current. The spring armature is so connected to its support as to be capable of sensitive adjustment in order to regulate its action to the utmost nicety.

1774. "Electric arc lamps." L. B. MILLER. Dated April 9. 4d. Relates to improvements in electric arc lamps, whereby the inventor obtains, in a simple manner, great steadiness in the light. (*Provisional only.*)

1776. "Construction of incandescent electric lamps." E. MULLER. Dated April 9. 4d. 1st. The interior glass tubes or carbon-holders of the present lamps are dispensed with, and merely a glass bar is fixed across the platinum wires, so as to secure them, and prevent their touching one another. 2nd. The horse-shoe filament is made of boxwood (*boxus sempervirens*), carbonised in the ordinary furnace (or by the usual process of carbonisation), and the filament is connected inside the two carbon blocks with the platinum wires, these wires conveying the electric current through sealed orifices on the outside of the bulb of the lamp, instead of being connected through a special tube at the base of the lamp, as in existing lamps. 3rd. The carbon filament, which consists of boxwood (*boxus sempervirens*), is fixed by a much more simple method. By inserting the connecting wires in an aperture bored in each end of the carbon blocks, into which the filaments are inserted, so that the platinum fits quite tightly in the blocks. The horse-shoe filament is fixed into the carbon blocks in the same manner, being secured by cement, so as to produce a good conductor; the two conducting platinum wires then pass out of the bulb, where they are hermetically sealed into the glass.

1785. "Secondary piles or batteries." E. G. BREWER. (Communicated from abroad by G. Arnould and R. Tamine, of Belgium.) Dated April 9. 6d. Instead of the metallic electrodes now generally employed in secondary piles or batteries, according to this invention metallic electrodes made of wires or bands of suitable section are wholly or partially used, and the said wires are arranged in any desired form or shape.

1789. "Galvanic batteries." G. BARON DE OVERBECK. (Partly a communication from abroad by D. F. Hornung, of Magdeburg.) Dated April 9. 4d. The inventors construct a primary battery composed of elements the one electrode of which consists of carbon alone, or platinum alone, or carbon covered with platinum, or lead or any other metal or substance covered with platinum placed in an oxidising fluid or solution yielding chlorine—the other electrode consisting of aluminium metal placed in a solution of alkalies and alkaline carbonates. It is preferred that the carbon electrode should be immersed in a mixture of chromate of potash, sulphuric acid and water, and the aluminium electrode immersed in a soda solution.

1794. "Secondary batteries." R. TATHAM and A. HOLLINGS. Dated April 10. 6d. Consists essentially in constructing frames or supports of grooved or channelled strips or bars of lead or other suitable metal preferably perforated and corrugated combined together so as to surround and enclose the plate of active material.

CORRESPONDENCE.

The time of acquiring Magnetism in the Electro-magnet.

The following analogy upon the time of acquiring magnetism in similar electro-magnets of different sizes will, I hope, prove interesting from a telegraphic point of view, as it seems to indicate the necessity of using as small electro-magnets as possible in rapid working telegraphic apparatus.

When the armatures of similar dynamos, differing only in size, are rotating with the same linear velocity, the angle of the lead of their brushes is always the same; but since the time of describing the same angle varies as the dimensions of the dynamo, then, assuming that the lead of the brushes is proportional only to the time occupied in the armature being demagnetised, it follows that the time occupied in magnetising or demagnetising the armatures is proportional to their dimensions.

Or, if an electro-motor, consisting simply of an electro-magnet acting upon an iron armature is considered, it is found with such an electro-motor that when it is performing work proportional to its mass, that the time of vibration of its armature varies as the dimensions of the electro-magnet; and it, therefore, follows that the time of its acquiring magnetism must also vary as the dimensions of the electro-magnet.

When two such electro-motors of similar shape and the same size are wound with wire of different lengths (the weights of the wire being the same) it is found that the different methods of winding the wire has no effect upon the time occupied in the magnet acquiring its magnetism. For when the product of the strength by the length of the current in each electro-magnet is the same, and the play and the lead in each of the armatures is also the same, then the time of vibration of the armatures will be identical, proving that the time of acquiring their magnetism of the two electro-magnets is the same.

It, therefore, follows that the time of acquiring and losing magnetism in electro-magnets varies only as their dimensions or the cube root of their mass, and as a constant dependent upon the shape of the electro-magnet.

W. Moon.

Electric Lighting.

In your issue of the 8th instant you have a notice of the installation of electric lighting at the Gaiety Theatre, Glasgow, such being described as effected by two systems, the "Swan" and the "Jablochkoff." You will allow me to state that such is a mistake, the entire lighting being carried out by the Jablochkoff Company, and on their own system. The Swan incandescent globelets were, it is true, used, but so might any other type of "incandescent lamp," and to say that it was the "Swan" system is as absurd as if it were stated that a gasfitter put up an installation carrying out same on the "Argand" or "Sugg" system, because one or other of these types of burners were used in the "gasoliers." In the case of the theatre in question, as well as the Lyceum, in Edinburgh, the dynamos were the Gramme alternating, as specially made for the Jablochkoff system; the coupling of the coils and the entire arrangement was by the plan adopted by that company in incandescent lighting, and by which a dynamo of given electrical capacity runs more "incandescent lights" than can by any other system be carried out.

In the two installations named, whatever is due to "Swan" globelets would have been alike due to any other type of incandescent lamp; the "Jablochkoff" Company alone had the selection of the "burners," and if credit be due, to them, and to them alone, does it belong.

Electron.

December 10*th*, 1883.

[Although we insert our correspondent's letter, we do not see what he has to gain by its insertion. We are under the impression that the "incandescence" and "arc" are two distinct systems of electric lighting, leaving out of the question the type of lamps employed. —EDS. ELEC. REV.]

Practical Electric Lighting.

Messrs. Coxon & Co., the well-known drapers, in Newcastle-on-Tyne, have for the last twelve months had on their extensive premises one of the best instalments of electric lighting in operation in Great Britain. At the present time two show rooms, artistically arranged and furnished with elegant and delicately-coloured apparel for ladies, are now open for inspection; those rooms are each lighted by 33 Swan 20-candle lamps, and the remainder of the establishment is illuminated by 130 Swan lamps. There are three Siemens dynamos, driven by a steam engine worked up to 30 horse power, and the general effect of the illumination is perfect, there being no visible flickering in the lamps. This steady illumination has been proceeding without hitch for twelve months. In addition to the internal Swan lamp lighting, a 3,000-candle Siemens arc lamp lights the outside of the premises.

T. P. Barkas.

28, Lovaine Place,
Newcastle-on-Tyne,
Dec. 5*th*, 1883.